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TECHNOLOGICAL EDUCATION IN GREAT BRITAIN

THE debate on technological training in the House of Lords on March 14 and the subsequent discussion at the special conference on higher technological education in Great Britain arranged by the Advisory Council on Scientific Policy on March 27 did not, of course, reveal the Government's proposals for the future expansion and organisation of higher technological education in Great Britain, but they clarified the issues in several important respects. Sir Henry Tizard made it plain that the Government is both anxious for guidance and desirous of resolving the conflict of opinion as to where and how such technological training could best be given. There is clearly a desire to consult every important section of professional opinion, and the fears in regard to the professional institutions which were voiced by Viscount Caldecote in the House of Lords debate have slender foundations. The assurance given by Lord Darwen in regard to consultation should remove most misgivings on this issue, and was fully endorsed at the conference held in the Royal Society's rooms on March 27 (see *Nature*, April 22, p. 627).

Lord Darwen's reason for the delay in consulting the professional institutions directs attention to a second point which has been clarified in these discussions. He pointed out that the whole problem had been put by the Minister of Education to the National Advisory Council on Education for Industry and Commerce nearly two years ago, and that that body had been asked to consult all the interests concerned —the universities, the technical colleges, the local education authorities, the professional institutions and industry—and to find a solution as quickly as possible. The first essential, he pointed out, is to get co-operation between the universities and the local education authorities. Many authorities are concerned and the negotiations have proved extremely difficult. Lord Darwen referred incidentally to difficulties, besides those of organisation or constitution, which have hampered the technical colleges in attempting to provide higher technological training, such as deficiencies in accommodation, equipment, staff, facilities for research and postgraduate work and lack of freedom for experiment.

By implication, rather than by explicit statement, as was made elsewhere, his speech showed that the question of higher technological education lies right outside the field of the technical colleges in general, as at present constituted. Their function is essentially the provision of the vastly greater number of technicians which industry also requires; and to equip and staff them essentially for the training of technologists would impede the performance of their primary function. Failure to keep this distinction clearly in mind is largely responsible for the confusion of thought and lack of progress in the past five years since the report of the Percy Committee. The position has scarcely been improved by the reference of the problem to the National Advisory Council on Education for Industry and Commerce instead of to the University Grants Committee, even if to do so

would have involved, as was suggested in the House of Lords debate, revision of the terms of reference of the latter Committee. Nor has it been helped by the draft report recently submitted to the annual general meeting of the Association of Technical Institutions, with its renewed advocacy of a national qualification in technology and a body to approve courses.

The fallacy of such ideas was well exposed both in the House of Lords and at the conference arranged by the Advisory Council on Scientific Policy, and there should be no longer any confusion between the two entirely separate problems: first, the place and content of higher technological training, and secondly, the reform or improvement of the technical colleges to provide the increasing number of technicians required. It is with the former alone that we are here concerned, and probably the most important suggestion made in the House of Lords debate was that the terms of reference of the University Grants Committee should be revised to enable the Committee to guide, help and support any institutions which are giving education of a university standard. Lord Darwen, who replied for the Government at this debate, completely ignored this suggestion, however, although Lord Webb-Johnson, who immediately preceded him, had concluded his speech by strongly supporting all that had been said on this point by previous speakers. It was not pressed at the conference arranged by the Advisory Council on Scientific Policy, in spite of the recommendation in the last annual report of that body. Even those speakers who urged most strongly that the universities themselves are capable of meeting the demand for higher technological education made no reference to it or questioned the appropriateness of the National Advisory Council on Education for Industry and Commerce for dealing with higher technological training. Yet whether the fears of Prof. A. R. Todd and Sir Lawrence Bragg as to the ability of the universities to organise the necessary expansion in higher technological education without becoming lop-sided or adversely affecting their proper work are justified or not, such expansion must fall within the purview of the University Grants Committee if it is to be planned effectively without wasteful overlapping or dissipation of resources. Nor can the experiment of establishing at least one institute of higher technology in Great Britain, on the lines so powerfully urged by Lord Cherwell with the support at this conference of Sir John Cockcroft, Sir Lawrence Bragg and Prof. S. Zuckerman, well be undertaken except under the guidance which that Committee is best equipped to give.

These two discussions brought out more clearly the distinction between technological education and technical training, and the need for the former to be considered together with university education by some authoritative body competent to deal with both. They also settled fairly conclusively that the demand for higher technologists is not of such a magnitude as to distort seriously the work of the universities if an attempt is made to meet it within the universities or in close association with them. Dr. A. E. Trueman's views on this point were endorsed at the conference by Mr. G. J. Nash, of the Appointments Department of the Ministry of Labour, who said that his Department's statistics indicate that the present demand by British industry does not greatly exceed the present supply and shows no signs of increasing substantially. That position does not affect the question whether, for reasons such as Prof. Ubbelohde, for example, has advanced, technological training is best given in separate institutions rather than in university departments; but it does rather undermine Lord Cherwell's argument that the universities cannot be expanded to do the work effectively without changing their whole character.

In such respects the discussion on March 27 has clarified the issues and demonstrated that, so far as higher technological education is concerned, no more than a relatively small expansion is required, and one that quantitatively may be within the capacity of the existing universities, even if qualitatively it may require some general planning on the lines indicated six years ago by Lord Simon in his pamphlet on university development. Even so, experiment with one or more new institutes of higher technology may be required before we can determine whether such instruction and training are more appropriately given in university departments or in new and separate institutions. Lord Darwen, in the House of Lords, acknowledged that this is an attractive suggestion; but unfortunately his speech stood alone in its failure to appreciate clearly the difference between the technical colleges and the technological institutions here under discussion. Not only did he fog the issue also by advocating for the technical colleges a new award carrying equivalent status to a university degree, but also he suggested that, for technologists generally, training could be given appropriately either in universities or in technical colleges.

With the Government spokesman thus failing to appreciate the distinction and confusing the issues after such an admirable succession of speeches, there is no room for complacency, and it is clear that in spite of repetition the debate must go on. The confusion in Lord Darwen's mind thus revealed is bound to detract from the confidence which professional institutions might otherwise have felt in his assurance about consultation, particularly after such a speech as that of Lord Caldecote, whose plea for open discussion they would do well to heed. Without such discussion it will indeed be difficult to establish the atmosphere of confidence and goodwill in which misunderstandings are removed and the essential co-operation fostered.

Lord Caldecote's remarks on the distinction between the technical colleges and the universities and the different purposes they serve, on the danger of overloading the universities with technical education, on the danger of awards to the technical colleges clashing with the qualifications of the great professional institutions which have already earned their prestige and status, and on the contribution of those institutions to the maintenance of standards of technical education and qualification, could not well have been bettered. Lord Chorley, too, stressed the difference between technologists and technicians,

while confining his remarks to the former in a strong plea that technological training should be undertaken within the universities and should be the responsibility not of the Ministry of Education but of the University Grants Committee. Both speakers, like Lord Cherwell who followed, insisted that the distinction is one of function and not of status; and the doubts here expressed as to the desirability or practicability of developing the technical colleges for this purpose rest solely on the question of function.

Lord Darwen's speech suggests that there is grave danger that this is not yet appreciated by the Government, and particularly the danger that the proposed new award, whether through a new body set up for the purpose or in some other way, may both fail to provide Britain with the first-class technologists it requires and deflect the technical colleges from their primary and essential function of providing the much larger numbers of competent technicians which are also needed. If the new award is not of university status, the status of a university degree may possibly be debased. If, however, it approximates to university status, and assuming that there could be found both the teachers and the equipment for dealing with fundamental sciences in the technical colleges, there is the even more serious danger that the technical colleges would evolve into something much less suited to the needs of the country.

It is important to-day to ensure that the work of the universities is not hampered by the presence of students incapable of obtaining the full value of a university education and whose real need is technical training. It is no less important that the technical colleges should provide the courses and instruction which the technician requires. Some technical colleges at present are scarcely capable of producing good technicians, just as the universities themselves have many students unlikely to become first-class technologists. Moreover, not many students at technical colleges are capable of profiting by teaching of university standards; if it were offered, it is doubtful whether the present students would master the theoretical and practical training involved. Leaving aside all question of staff difficulties or the problems of finance and government on which Mr. H. Richardson touched, a technical college, reconstituted and re-graded to teach technology, would *ipso facto* be deflected from its original and proper purpose.

It cannot be too strongly reiterated, therefore, that we can either train the technologist in institutions founded on research and fundamental science in that atmosphere of higher learning which we associate with a university, or we can train technicians in a specific skill with the tools required for that skill. We cannot do both at once in the same institution. Every proposal to transfer a technical college from its function of training technicians into one of training technologists, whether under the name of institute of technology or any other, should involve as corollary the provision of some new technical college to provide in that locality the means for training the even larger number of technicians which industry requires.

Once these two issues are clearly distinguished and tackled on separate lines, we can hope for progress. The matter of technicians may well continue to be an appropriate responsibility of the Ministry of Education, though some provision should be made for co-ordination with the policy of technological education so as to ensure that changing needs are met. Technological education is as clearly a matter to be developed in association with the development of university education and under the same authority. Its ideas and ideals derive from the same source and require the same correctives against specialization, as is well illustrated by Prof. P. M. S. Blackett's contribution on "Training for the Professions" to a recent series of broadcast talks on "The Idea of a University".

Prof. Blackett's attack on Newman's idea of a university, and his plea that, at any rate on the science side, the task of the universities is specifically a vocational one, is, of course, largely in keeping with an earlier ideal or tradition of the universities, as indeed Sir Walter Moberly recognized in his book and Lord Lindsay stressed in his broadcast talk in the same series on "The Dual Task in Higher Education". Much that Prof. Blackett said needed saying, particularly his reference to the creative aspect of scientific work, the need for depth of studies and the narrowness being found in arts as well as in science faculties. He was on less firm ground in his remarks about changing the material background of the students' lives, appearing to discount somewhat the value of halls of residence even if the conditions of a student's home life were vastly improved. Nor was he happy in his reference to the failure of British universities to play a leading part in the main social and intellectual movements of their times. It has never been contended in current debate that the universities themselves should, in fact, show that leadership, but rather that they should provide the nation with men and women whose education will have fitted them to provide that leadership. Prof. Blackett's argument is still more questionable when, and if, it is contended that the majority of our young physicists and chemists are educated people, or even, in fact—judged by the vocational standards of the past—good professional people. Some undoubtedly are, but they owe it rather to their home influence or to their own efforts than to anything that the university has provided for them. Lord Lindsay of Birker made some sound remarks in this connexion, recalling the late Prof. S. Alexander's definition of the purpose of a university, with its stress on the pursuit in a liberal spirit of the various sciences which are a preparation for the professions or higher occupations of life.

Most recent discussions on the policy which should be pursued in the development of technological education in Great Britain have fully recognized the importance of this liberal spirit, and that the task of the institute of technology is to prepare for a profession or technology by pursuing the sciences on which the profession or technology is based. It has also been admitted more freely than Prof. Blackett appears to do that science faculties have much to learn from the Continental technical high schools, and

this is one reason for experimenting with a new type of institution in Great Britain. There is no suggestion that any such institution would be limited to mere technological training, but rather that it would attempt also to supply that deficiency to which, for example, the disconcerting frequency with which technologists from civil life fail to pass the tests for leadership of the Regular Commissions' Board bears witness.

It is not, therefore, enough to vindicate, as Prof. Blackett does, the quality of the technical training now being given in the science faculties. The universities must contribute to the solution of the problem of values as well as of technical problems. They are not incompetent to train leaders for a changing society, and what the world needs is not merely competent scientists and technologists of all kinds but also persons of judgment and character. For this reason alone, as Sir Walter Moberly indicated in the concluding talk of the series, even this debate on where and how the training of our higher technologists should best be undertaken cannot disregard the deeper question of the basic values of a university or the place of the university in the sifting of ideas. Otherwise, as Sir Walter points out, we may find that, as a result of pre-occupation with secondary issues, major decisions are taken unconsciously and through sheer inertia.

ZOOLOGICAL NOMENCLATURE

Nomenclator Zoologicus

Edited by Dr. Sheffield Airey Neave. Vol. 5, 1936–1945. Pp. v+308. (London: Zoological Society of London, 1950.) 73*s.* 6*d.*

THE zoologist who wishes to create a new genus is faced by the problem of devising a name which has not been previously used in this capacity, otherwise it will become a homonym and join the long list of discarded names. It is obviously impossible for anyone to know more than a small fraction of the generic names in use, and various attempts have been made to provide up-to-date information in the form of lists. The first of these lists, prepared by L. Agassiz, was produced more than a century ago; this was followed by S. H. Scudder's "Nomenclator Zoologicus", and the "Nomenclator Animalium Generum et Subgenerum" published by the Prussian Academy of Sciences.

None of these efforts, however, has been entirely satisfactory, for they were neither complete nor up to date, and systematists found themselves in difficulties for the lack of a collected list. C. D. Sherborn's great work "Index Animalium" dealt only with publications up to 1850, and the annual lists published in the "Zoological Record", at least in the earlier volumes, were apt to contain altered names, according to the views of individual recorders.

The first edition of the present work was published in four volumes during 1939–40 and was financed privately by the editor, Dr. Sheffield A. Neave, and by Mr. R. W. Lloyd. It contained a list of the names of genera and subgenera in zoology from the tenth edition of "Linnæus" (1758) to the end of 1935. The work contained rather more than 225,000 entries, and it met such a widespread demand that by 1946 a large part of the edition had been sold out and, rather surprisingly for so technical a publication, had also been a financial success. In that year the "Nomenclator Zoologicus" was placed on a more permanent basis by an agreement made with the Council of the Zoological Society of London whereby the surplus of about £1,200, together with the existing stock, was transferred to the Society with the object of creating a permanent Neave–Lloyd Nomenclator Zoologicus Fund to finance the cost of future supplements which it is hoped to publish at ten-year intervals.

The first of these has now appeared as Vol. 5, and deals with generic names that have been added between the years 1935–45 inclusive, more than 18,000 in number, and also a few hundred names omitted previously. It has been prepared on the same lines as the earlier volumes, the name of the genus or subgenus being followed by that of the author, then the date of publication and the reference, in which the abbreviations used in the "World List of Scientific Periodicals" have been adopted. Finally, the class or order to which the animal belongs is given.

All zoologists are greatly indebted to Dr. Neave, not only for the labour involved in producing this important publication, but also for helping to get it placed on a permanent footing. It is scarcely necessary to add that no zoological library or institution can afford to be without it. It is peculiarly appropriate that the Zoological Society of London, which is also responsible for the "Zoological Record", the most comprehensive annual reference work to zoological literature, should have now undertaken to publish the supplements of the "Nomenclator Zoologicus".

ADVANCES IN BIOCHEMISTRY

Annual Review of Biochemistry

Edited by J. Murray Luck, Hubert S. Loring and Gordon Mackinney. Vol. 18. Pp. ix+739. (Stanford, Calif.: Annual Reviews, Inc.; London: H. K. Lewis and Co., Ltd., 1949.) 6 dollars.

BIOCHEMISTS will welcome the appearance of Vol. 18 of the "Annual Review of Biochemistry". Announcing in the preface to this volume the decision to transfer to a new review, the "Annual Review of Plant Physiology", those aspects of biochemistry concerned with plants and soils, the editors write: "It is . . . our hope and confident expectation that all investigations of a fundamental character, whether the subject be a plant, an animal or a micro-organism, will continue to find a place in the 'Annual Review of Biochemistry' ".

In the volume here considered, three articles are devoted exclusively to plant biochemistry. The review by A. G. McCalla on the nitrogenous constituents of plants includes a useful summary of recent physico-chemical studies on seed proteins. Advances in ideas concerning the acid metabolism of plants during the period 1940–48 are reviewed by T. A. Bennet-Clark; and C. H. Wadleigh reviews for the period 1947–48 the mineral nutrition of plants.

Micro-biological chemistry is represented in this volume by two articles: on metabolic inhibitors, by R. J. Winzler, and the chemistry of antibiotics, by O. Wintersteiner and J. D. Dutcher. The remaining

eighteen articles are concerned with topics which relate chiefly to animal biochemistry; their range is great, extending from biological oxidations, by P. W. Preisler and F. E. Hunter, jun., to insect biochemistry by V. B. Wigglesworth. The excellent article of F. Lipmann and N. O. Kaplan on intermediary metabolism of phosphorus compounds, which covers the period December 1946–December 1948, should, in view of the widespread participation of phosphorylation reactions in biological processes, prove of great interest to all biochemists. These authors and H. G. Wood and V. Lorber, in their article on carbohydrate metabolism, both present accurate accounts of the work initiated by the Cori school on the effect of hormones on the hexokinase reaction. Lipmann and Kaplan do, however, emphasize that a number of observations suggest a role of insulin in the aerobic phase of metabolism. The article by D. J. Bell on carbohydrate chemistry takes the form of a critical review of developments during the five-year period up to October 1948 in the handling of small amounts of carbohydrates and their methylated derivatives; it will certainly prove of very great use to all carbohydrate chemists.

In general, the contributors to this "Annual Review" maintain the high standard of accuracy and criticism which we have now learned to expect of it. A minor criticism which may be levelled concerns the method of literature citation; although a few authors list their references in alphabetical order, this arrangement is not generally followed. My biochemical colleagues and I find that an alphabetical listing of references does assist very considerably in the tracing of papers. May I, therefore, with the reviewer of an earlier volume of this publication, ask that this method of arranging references be adopted in future issues?

R. H. Smith

DARK PLACES OF THE MIND

The Inner Experience of a Psychoanalyst

By Theodor Reik. Pp. xiv+514. (London: George Allen and Unwin, Ltd., 1949.) 21*s*. net.

DR. THEODOR REIK belongs to what may be described as the 'Old Guard' of psychoanalysis: he was personally analysed by Freud and was in communication with him until his death. In this book he sets out to explore what he calls the last dark continent on earth, by which he means that he attempts to analyse the mind of the analyst at work. Many books have been written describing the thinking of the patient under analysis, and his behaviour has been recorded in minute detail; but often the psychoanalyst has been reluctant to turn his searchlight back to illuminate the dark places of his own mind, although it was by this way that Freud added much to his knowledge.

As Reik points out, "when you want to recognize and understand what takes place in the minds of others, you have first to look into yourself. Such a search is possible when a division of yourself has preceded the observation. The premise for psychological interest is thus a disturbance within the person. Without it no possibility of recognition exists." Reik argues from this that some sort of disturbance must have taken place in Freud's mind in order that the latter could possess such remarkable insight, and brings forward the fact, suggested by Siegfried Bernfeld, and admitted by Freud to Reik, that Freud himself had had a mild agoraphobia which he had cured by self-analysis.

Self-examination—the procedure by which William James says "The *I* observes the *Me*"—is made possible only by splitting the ego in two: the part which looks, and the part which is observed. Reik believes that this is developed by the fact that the child realizes that it is watched by its parents and nurses. "The attention the persons of his environment paid to the child will be continued by the attention the child pays to itself." Reik develops this psychological argument in the first part of his book, and one hopes that he will lead on to something further; but unfortunately he then appears to lose much of the thread of his argument, and the following chapters become more and more reminiscent, although, with descriptions of patients' analyses, witty memories of 'characters' in old Vienna, and so on, it never loses interest and always remains readable.

It is unfortunate that Reik seems embittered with the American psychoanalysts, and here and there he injects a sub-acid remark—for example, he says (p. 198), "As so often, Dr. Brill's translations of Freud's writings, which are read by most American students, are worse than bad: they are mediocre". This gives one the impression that he is not altogether happy in the land of his adoption and longs to be back in the Vienna of his youth. Yet when he writes about himself and analyses his own dreams—as always, if a human being bares his thoughts—his very humanity makes one like him. He shows himself as a widely read physician who has a very extensive knowledge of psychological literature of every kind, in addition to a life-long experience of psychoanalysis. He seems also to have had a wide acquaintanceship with many interesting people—musicians, artists, and so on—which gives him opportunity of drawing on a well of fascinating reminiscence to illustrate almost anything which he wishes to describe. Although the book does not really succeed in enlightening one on the processes which take place in the mind of the analyst, there is much in it to interest even an experienced worker.

The book is well printed on good paper and has a pleasant dark-red binding. It lacks an index, so that it is difficult to re-discover facts one has read in the text.

Clifford Allen

SOLAR PHYSICS FOR THE LAYMAN

Our Sun

By Donald H. Menzel. (Harvard Books on Astronomy.) Pp. ix+326. (London: J. and A. Churchill, Ltd., 1949.) 21*s*. net.

THIS book is the latest in the series of Harvard Books on Astronomy. It is up to date, attractively printed, well illustrated and very easy to read; but, like some of its predecessors, it has raised more questions in my mind than the author probably intended. The dust-cover states: "This series of books is based upon original investigations by eminent authorities, but the presentation is directed to the nontechnical reader. It provides a comprehensive survey of astronomy adapted to the needs of students, written in a manner that will delight and entertain the reader as well as impart the facts." My chief worry hinges on the word "students". A book

of this kind can do good service for the many intelligent non-technical readers among the general population who wish to make some acquaintance with present-day astronomy; but on the other hand it seems to me to carry a danger for students, whether in the sixth form at school or in their undergraduate years. Unless specifically warned by someone with more experience, young men may easily get the impression that scientific research, or in particular astronomical research, is all 'cake and jam'. It is not uncommon for teachers, in other sciences as well as astronomy, to meet pupils whose imaginations have been fired by books of this kind, but whose enthusiasm tends to evaporate rather rapidly when confronted with the discipline of systematic academic learning, even before the sweat and tears of research. As a preparation for a scientific career, there is something to be said for a puritan upbringing.

This book was started some years ago and then interrupted by the War. It shows evidence, both in text and illustrations, of having been finished rather hurriedly. The post-war period so far has not given much opportunity for quiet reflexion, so desirable for the writing of a book, and perhaps this is to be blamed for the rather numerous imperfections. Then, too, for some curious reason or other, it seems to be extraordinarily difficult to write a book on popular astronomy without incurring a considerable amount of criticism from one's professional colleagues; and, if Prof. D. H. Menzel finds himself in this respect in the distinguished company of Jeans and Eddington, it may in part be a measure of the difficulty of the task, or even of the unreasonableness of one's fellow astronomers.

To criticize in more detail: p. 5 may suggest to some readers that the majority of stars in the sky are variable. There is no good positive evidence for this, for, so far as astronomical photometry has proceeded until now, most of them seem to radiate as steadily as the sun. On p. 18 it should have been emphasized that transits of Venus are not suitable for accurate measurement of the solar parallax, as was discovered last century by numerous expensive expeditions. The important Potsdam work on granulation appears to have been ignored (p. 156). Ionized helium is not always brilliant in the flash spectrum (p. 165); it could not be detected in the low chromosphere at the 1940 eclipse. Ergs have been written for calories at the foot of p. 230. The statement (p. 277) that "The need for special photographic and spectrographic studies, at time of eclipse, is diminishing" cannot be accepted without qualification. The work of the past ten or fifteen years has raised important new questions, especially about the corona, which can be answered only by eclipse observations. There is some unnecessary repetition; for example, narrow-band filters are discussed on p. 146 and again on p. 195. More could have been written on such matters as solar radio noise, and less on such subjects as uranium-235 and the atom bomb.

The illustrations are numerous, and for the most part are good. However, the charming young lady in Fig. 17 will ruin her left eye if she continues to observe the sun as depicted. Prof. Pannekoek's friends will be glad to see his portrait in Fig. 63, but will regret that he is not mentioned in the text. There is an excessive number of eclipse photographs of the corona, no better and no worse than the majority of those published elsewhere; that is, they show the corona as a nearly amorphous mass, whereas the most striking characteristic to the naked eye is its structure and spikiness. In this respect, two or three good drawings would have given the reader a better impression than five times their number of photographs; a remark on p. 189 suggests that the author is inclined to share this view. Figs. 174–177, to illustrate the correlations between sunspot numbers and other phenomena, are unlikely to convince a sceptic.

It would be unfair, however, to suggest that blemishes of this kind are the dominant feature of the book. "Our Sun" is no substitute for the authoritative treatise on solar research so urgently needed at present, and which Prof. Menzel himself is so well qualified to write; but the non-technical reader looking for an easy introduction to the sun as we know it to-day, who has no objection to a rather flamboyant style of writing, should be able to read it with pleasure and profit. R. O. REDMAN

CATION EXCHANGE IN SOILS

Cation Exchange in Soils

By Prof. Walter P. Kelley. (American Chemical Society, Monograph No. 109.) Pp. xv+144. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1948.) 27*s*. net.

THE phenomenon of base exchange in soils, or of cation exchange as it is now called, was first described by J. T. Way, chemist to the Royal Agricultural Society of England, in 1850, just one hundred years ago. Hence this book, by a well-known American research worker in the subject, has come most opportunely, as it forms a timely memorial to a century of progress in a subject which looked very simple to begin with, but which has given a great deal of theoretical trouble in the past. This is a particularly favourable time to review the subject for quite another reason: the phenomena can now be explained quite adequately on a semi-quantitative basis in a way that is readily intelligible to the general scientific worker, while the next stage in the theoretical development of the subject will probably be the application of statistical mechanics to put the current explanations of the phenomena on a more quantitative basis.

Prof. W. P. Kelley has given an excellent account of the historical development of this subject. He was a leading worker in it twenty-five years ago and has been actively interested in it ever since. He has succeeded in many places in giving a clear account of many of the earlier theories and has dealt with them sympathetically, perhaps because the outlook is often rather old-fashioned. But unfortunately some of the really fundamental properties of cation exchange do not seem to have had an adequate discussion. Thus there is no explicit discussion on the conditions under which the exchange equilibrium is reversible, and this is particularly unfortunate because in the past there was very little evidence for its true reversibility.

The book deals with other subjects besides cation exchange in soils. There is a very useful chapter on methods of determining exchangeable cations in different types of soils, and short but rather uncritical chapters on the composition of the exchangeable cations in soil, on the effect of exchangeable cations on soil properties, and on methods for identifying clay minerals. E. W. RUSSELL

The Philosophy of Plato

By Prof. G. C. Field. (Home University Library of Modern Knowledge, 207.) Pp. 220. (London: Oxford University Press, 1949.) 5*s*. net.

FEW people would deny that to be devoid of a working knowledge of the classical languages is a disadvantage: at the same time, however, it is possible to exaggerate the importance of linguistic competence, when the aim is predominantly comprehension of an abstract theme rather than a deliberate study of literary style. With this reservation, the reader of Prof. G. C. Field's masterly little book can count himself lucky indeed. In a way somewhat hard to describe, the author has managed to keep the Greek feeling for words and their fitness, while at the same time carrying us along in contemporary English. We are left in no doubt as to the writer's vigorous defence of Plato against some irresponsible modern criticism, which criticism suggests strongly that the wish is father to the thought.

Much of the available space is rightly devoted to a discussion of the theory of forms and of the final metaphysic. The Platonic habit of placing reason above myth and poetry is significant, not only as a healthy corrective to the temptation towards 'romancing', but also because it honestly faces the sheer impossibility of describing the deepest philosophical truths by means of the written word. There is a distinct twentieth-century touch about this, inasmuch as the common man of to-day is apt to complain rather petulantly when men of science assert that they cannot explain their fundamental concepts in words at all.

Plato was no lodger in an ivory tower: he strove to bring the work of a tremendous intellect into harmony with human needs as he conceived them, reserving its highest flights as the priceless possession of the good life. F. I. G. RAWLINS

Both Sides of the Road

A Book about Farming. By Sidney Rogerson. Pp. 183+23 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1949.) 21*s*. net.

MANY books have recently been written about farming with the view of instructing present or prospective farmers, but this one is intended for a much wider public: it aims at giving a picture of present-day English farming and of the men who are doing it. Starting from Yarmouth, the author describes an agricultural journey to Devonshire, with digressions on the way; then, starting from London he goes northwards. Later chapters deal with the crops, the animals and the systems of farming. The descriptions are good and the comments sound; the illustrations are excellent. The book is easily readable and can be enjoyed alike by laymen and farmers; it can be specially commended to Young Farmers' Clubs.

A few mis-statements need correction if a subsequent edition is printed. It is not true that soil in China, as the result of the special methods, "is neither worked out nor in danger of blowing away"; Dr. H. L. Richardson's recent publications give a far less favourable account. Buckland's view of the origin of coprolites is not now seriously taken to explain the presence of phosphate in soils. These, however, are only incidental statements and do not affect the main structure of the book.

The author rightly emphasizes the high degree of intelligence of the modern farmer and his keen interest in agricultural education; indeed, he claims that nothing approaching the farmer's avidity for knowledge exists in any other industry. He also rightly stresses the amazing ignorance of agriculture and country life on the part of town-dwellers. It is hoped that this book may provide some remedy.

E. JOHN RUSSELL

Odmerná Analysa (Volumetric Analysis)

By O. Tomíček. Pp. 372+viii+70 Figs. (Prague: Czechoslovak Chemical Society, 1949.) 215 crowns, or 21*s*. 6*d*.

THE first Czech text-book on volumetric analysis was one by Preis which went through two editions in the 'nineties. Several others appeared prior to 1939, including Prof. O. Tomíček's introductory work of 1932. His present comprehensive volume is intended for advanced students and covers a wide field, including many modern adaptations such as the developments of potentiometry (his own branch) and polarimetry (titrations involving Heyrovský's polarographic procedure).

The subject is fully treated from both theoretical and laboratory points of view. One feature is the lengthy table of dissociation constants that includes the organic acids and bases. In each individual chapter dealing with the various methods (neutralization titrations, redox processes, iodometry, use of titanium solutions, silver nitrate, mercury salts, etc.) worked examples are shown.

Though the author scarcely mentions it, Czech chemists have themselves contributed to the advancement of volumetric analysis. Štolba, in 1878, devised a volumetric method for estimating cerium; Votoček (1919) introduced a mercurimetric method for determining halides, and it was later extended for cyanides; Knop (1925) introduced diphenylamine as an internal indicator in the dichromate titration of ferrous solutions. Besides these, notable improvements were devised in well-established methods; among them must be mentioned Tomíček's own potentiometric method for determining halides in the presence of sulphites. J. G. F. D.

British Waders in their Haunts

By S. Bayliss Smith. Pp. ix+162. (London: G. Bell and Sons, Ltd., 1950.) 21*s*. net.

THE birds of mudflat, estuary and shore have ever an especial fascination for the ornithologist. In "British Waders", Mr. S. Bayliss Smith approaches his subject from the shore-watcher's angle, illustrating it with some remarkably fine photographs, mostly taken by himself. His remarks on wader photography will be helpful to those intending to try their cameras on this difficult branch of bird photography. The studies here shown will enhance their keenness: for example, on p. 25, the striking snapshot of small waders making way for a great black-backed gull, and the decorative study that we find on p. 21 of a group of waders with a turnstone in full breeding plumage in their midst.

Yet this is not a mere picture book, the letterpress being the result of personal observation and affording good reading. The author tells us that "on green-marsh and salting, on mudflat and tidal creek, may be found, at one and the same time, a zoologist's observatory, an artist's studio and a bird watcher's paradise", adding that, once you have fallen under the spell of the "wading fraternity", there is no escape. This volume is likely to bring yet more folk under that spell. FRANCES PITT

THE NATIONAL INSTITUTE FOR MEDICAL RESEARCH

THE National Institute for Medical Research has lately moved to its new home on the Ridgeway, Mill Hill. On May 5 it was formally opened by His Majesty the King, accompanied by Her Majesty the Queen. For almost exactly thirty years its home has been at Mount Vernon, Holly Hill, Hampstead. One cannot say that Holly Hill knows it no more, for the building there will still house the Institute's Human Physiology Division, along with others of the Medical Research Council's research units.

The new Institute is a most impressive building of white Broomhill brick. Its seven stories, topped by a green copper roof, stand up on the Ridgeway and are visible from the Barnet by-pass road, and many other viewpoints around; from the ridge opposite, at Totteridge, it appears enormous. Of the many establishments of the Medical Research Council, this is by far the largest and it is, of course, something which is wholly the Council's. For many years the Hampstead Institute had been slowly growing, in the sense that more and more workers were being accommodated and pressure on space was becoming heavier. The Council's decision, in 1936, to accept responsibility for a big new programme of work at the Institute, on chemotherapy, made a move inevitable. The new building, designed by Mr. Maxwell Ayrton, was begun in 1937, and the outer shell was complete in 1940. To finish and equip it at that time was clearly impossible. It was lent to the Admiralty for the preliminary training of Wrens (W.R.N.S.) between 1942 and 1946, and became for that period H.M.S. *Elizabeth*. Now, at last, its equipping is almost complete and it has returned to its intended purpose. It now houses a total staff of 335; ultimately the accommodation will suffice for 100 qualified workers and between 250 and 300 assistants and others.

The building's ground plan is an unusual one: the centre block is seven stories high; from each end of this sprout out two wings, set at an angle, but these only rise up for three stories. This form of the building was determined by the need for making the best possible use of the restricted amount of relatively level ground near the road; but it has the advantage of providing good lighting throughout. The two wings at the east end of the main building contain laboratories, as does the centre block; the wings at the west end (apart from the ground floor) house the quarters for experimental animals. Behind the centre block, away from the road, is the Fletcher Memorial Hall, for scientific meetings and other occasions. This is at ground-level in front, but has the extensive store rooms beneath it; it can seat 230. The name of the hall commemorates, of course, Sir Walter Fletcher, the Council's first secretary. In all there are 90,000 sq. ft. of working space. The building is heated by hot-water panels; most of the illumination is by fluorescent lighting. Services laid on to various laboratories include pressure water, steam, compressed air, A.C., D.C. of various voltages, while distilled water is available from a central piped supply to points in corridors. Laboratories have been designed in close collaboration with heads of departments. It is inevitable that in the fourteen years since the building was first planned there have been many changes of staff and many developments necessitating numerous drastic revisions in the original plans.

In the less specialized laboratories the benches are of teak, 2 ft. 6 in. or 3 ft. high as necessary; the doors, too, are teak. The floors in general are of cork squares. Standard steel laboratory furniture—cupboards, nests of drawers, and so on—are fitted and exchangeable with others held in reserve. In many rooms glass-fronted cupboards extend from a height of 6 ft. 6 in. to the ceiling, and these are conveniently reached by means of light aluminium ladders available in each room. The services are carried behind panels at the backs of the benches.

A tour of the Institute beginning at the bottom brings us first to the Division of Physiology and Pharmacology, where Dr. W. Feldberg and his colleagues carry on the traditions of Sir Henry Dale's laboratory. They are housed in the basement and sub-basement of the north-east wing; since the site of the Institute slopes sharply downwards away from the road, the laboratories are not so much underground as this description suggests. This position was chosen to enable them to have laboratories with a minimum of electrical interference. The problems of transmission of the nervous impulse still concern them, in particular the widely differing substances acting as histamine liberators, and the bisquaternary salts with curare-like action. Studies are also in progress on the activity of an isolated slab of cerebral cortex connected with the rest of the brain by its vascular supply only.

The centre block of the ground floor houses the office of the director, Sir Charles Harington, a conference room for small meetings, and administrative rooms. The south-west wing—and part of the north-west—accommodate the Division of Biophysics. This department, under Dr. A. S. McFarlane, has expanded more than any other of those from Hampstead, and now houses, in close proximity to each other, facilities for the application of many physical techniques to biological problems. Here are not only microscopy of various kinds, but also the routine photographical department, two electron microscopes, electrophoresis apparatus, ultrasonic equipment, electronic counters for radioactive isotopes, mass spectrometer for stable isotopes and some special freeze-drying and centrifuging equipment. The working benches are around the periphery of the wing; rooms for electron microscopes, photography, etc., are in the centre. At least half the time of those in the Division is taken up with work in collaboration with those in other departments. It is worth mentioning in this connexion that it is the policy of the Director, as it was of his predecessor, Sir Henry Dale, to prevent the various divisions from becoming water-tight compartments. In fact, a very large number of the researches in progress are joint ventures involving one or more divisions of the Institute.

Also in the north-west wing is a well-equipped fine-instrument shop with an attached electronics laboratory and a drawing office.

In the north-east wing of the ground floor and in part of the first floor is housed the Division of Biochemistry, under the Director and Dr. A. Neuberger. Its interests are in the biochemistry of the

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National Institute for Medical Research

thyroid, and in porphyrin and amino-acid metabolism. The application of radioactive isotopes to medical science is visible here in Dr. G. J. Popjak's studies of fatty-acid metabolism. Dr. A. J. P. Martin has lately joined the Institute's staff to pursue in the biochemistry department the art and science of paper chromatography. A radiochemical laboratory is in process of construction; it is intended to be used for the synthesis of compounds incorporating radioactive isotopes.

The north-west wing is largely devoted to the subject of chemotherapy, the development of which was largely responsible for the Institute's move. On the ground floor the laboratories of the Division of Organic Chemistry are mainly devoted to the chemical side of chemotherapy. Dr. Harold King, so long head of this Division, has just retired, being succeeded by Dr. J. Walker. Chemists working here have the advantage—which is, of course, mutual—of close contact with biologists in the field of chemotherapy (Drs. F. Hawking, J. D. Fulton and A. T. Fuller) working on the floor above them. New amœbicides and substances of potential activity against tuberculosis are among those now being synthesized and tested at the Institute. Other activities in the chemical laboratories concern cortisone, especially the testing of plant materials for possible precursors of cortisone; and co-operation with the department of pharmacology in the field of curarizing agents.

An important development in the Biological Chemotherapy Laboratories is the use of the lately discovered *Plasmodium berghei* for testing possible anti-malarials; this organism will infect mice, which are naturally more convenient than the canaries and ducklings which have been used so much in recent years. Chemotherapeutic research here is, however, tending to swing a little away from malaria and trypanosomiasis to the study of schistomiasis, filariasis and other worm infections. *Leishmania* and *Entamœba histolytica* also get their share of attention and, very naturally, the bacteria also, and, with luck, even the viruses. An appendage to this department is an insectarium for the rearing particularly of mosquitoes.

Also in the north-east wing is the Division of Bacterial Chemistry under Dr. M. R. Pollock. This Division contains the team formerly under the direction of Sir Paul Fildes at the Lister Institute. It is naturally hoped that their investigations on bacterial metabolism will contribute to the rational approach to chemotherapy.

Dr. W. J. Elford's small Division of Physical Chemistry is closely linked with biophysics on one hand, and with virus research on the other. Work is going on in all three of these Divisions to follow up the implications of the recent finding that recently isolated influenza viruses have filamentous forms.

In the centre block of the first floor is housed the Division of Experimental Biology under Dr. A. S. Parkes; its name denotes the wider scope of activity of the former Department of Endocrinology. Its studies now are especially of the fertilization and cultivation of mammalian ova *in vitro* and of the behaviour and preservation of mammalian and avian sperm *in vitro*. Dr. Parkes is responsible for the husbandry of the animals bred for experimental purposes and, with Miss Bruce, has developed diets of cubed foods suitable for various species.

On the second floor, the centre block contains the Division of Virus Research, an activity associated with the Institute throughout its history. This is now under the charge of Dr. C. H. Andrewes, and is, at present, interested especially in virus infections of the respiratory tract. Based upon it is the Common

Cold Research Unit at Salisbury. Within it also is the laboratory of the World Influenza Centre, an activity of the World Health Organisation; this keeps touch with laboratories all over the world and seeks, by gathering information and strains of virus from far and wide, to understand more of the global epidemiology of the disease. The histological laboratories (Dr. J. Niven) render help and co-operation to other departments of the Institute.

In the north-west wing of the second floor is the Division of Biological Standards, under Dr. A. A. Miles. The Institute undertakes responsibility for maintaining and distributing, under the World Health Organisation, standards of all those substances such as sera, vitamins and hormones for which biological assay is necessary. Other work is concerned with the operation of the Therapeutic Substances Act. At present, forty-five international or British standards are held in the Institute. Help in relation to biological standards is rendered by many in various departments of the Institute, and the members of Dr. Miles's own laboratories are able to give a large proportion of their time to research. At the moment this concerns particularly the action of cortisone and other hormones, and of shock and physiological changes, on the processes of immunity and infection.

On the second floor, in close proximity to the virus and standards departments, are the media preparation rooms. Here, and also among the viruses and standards, are special sterile rooms into which clean air is admitted under pressure after passing through filters situated above a false ceiling.

The 'Animal House' occupies the first and second floors of the south-west and north-west wings, and also the third floor of the latter. Two sets of swing doors cut it off from the rest of the building; but in any event the special ventilation system keeps it satisfactorily free from noxious smells. Some parts are thermostatically controlled. There are three separate isolation units—one specially for tuberculosis—and special precautions are applied to keep under control dangerous infections. Air from these units is treated separately from that from the rest of the building, being 'scrubbed' with chlorine before passing out by the incinerator chimney. The building contains infected animals only; normal breeding stock is housed in separate buildings and cared for by separate staff.

As already mentioned, the Institute above the second floor consists of a central block only. The third floor has purposely not been completed, being held in reserve for future unforeseen developments. Some encroachment has, however, already had to be made on this reserve space, and laboratories are being fitted for special biochemical work.

The fourth and mezzanine floors contain the library, and there is a consensus of opinion that this is one of the best features of the Institute. The central room is spacious and airy; there are extensive views to north and south from the windows; the most widely used journals are all easily accessible, the less-used ones being in the gallery above. There are side rooms for reference books and text-books, and ample stock rooms; also a series of small study rooms.

On the fifth floor is the canteen, which can seat 240; here the entire Institute staff can have lunch and tea, the mess being run on the cafeteria principle. There are coffee rooms for various sections of the staff.

In the sixth (attic) floor, besides storage tanks, are recreation rooms for assistant staff.

This account of the Institute is necessarily brief. Deliberately, little reference has been made to its past achievements, for these have been dealt with in Sir Charles Harington's lecture to the Royal Society little more than a year ago. Many of these achievements are well known; if they are not equalled or surpassed in the new environment, the workers there will have only themselves to blame. They have, however, one major disadvantage to contend with: Mill Hill is five miles farther from almost everywhere than is Hampstead. It will be necessary to make no little effort to see that the flowers of research blooming at Mill Hill are well and truly cross-fertilized by those put forth elsewhere. C. H. ANDREWES

THE TWO TYPES OF WHEAT ENDOSPERM

By E. N. GREER and DR. J. J. C. HINTON
Research Association of British Flour Millers, Cereals Research Station, St. Albans

FLOUR millers have long recognized two types of behaviour in the crushing of wheat endosperm, and distinguish between 'hard' and 'soft' types of wheat grain. The differences are such that the detailed layout of a modern mill is materially affected if required to grind either type separately. In a general sense, the hard wheat is easier to mill since it gives readier separation of bran from endosperm and the liberated flour is more mobile and easy to sift. Wheat grown in Britain, particularly the newer high-yielding varieties, is largely soft in character. An increase in the 'hardness' of the crop would therefore constitute an important improvement in the quality of the grain from the milling point of view.

Biffen[1], in his study "The Inheritance of Strength in Wheat", describes experiments in which grains were crushed on an iron plate. With some grains a fine powder was obtained, whereas others gave a gritty powder of angular fragments. In applying this test to the F_2 hybrids of a cross between soft and hard wheats (Rough Chaff and Red Fife) he noted that, judged in this way, the numbers of hard and soft hybrids produced were approximately in a Mendelian ratio. More recently, Berg[2] has pointed out that the milling behaviour of wheat may be judged from the extent to which finely divided flour, passing through a No. 15 silk (0·085 mm. aperture), is produced in a standard milling process, and he has put forward further evidence suggesting that genetic factors govern milling behaviour. The application of Berg's technique to standard varieties of English wheat has confirmed the fact that milling behaviour is affected little by variations in the composition of the grain[3].

The microscopic studies of flour from hard and soft wheat by Berliner and Rüter[4] showed that the former contained a large proportion of intact endosperm cells. By contrast, the larger particles in the flour from soft wheat consisted of groups of torn endosperm cells, few or no whole cells being present.

Some observations made on wheat grains as distinct from flour are described below:

(1) Slices (about 0·5 mm. thick) of completely vitreous grains were prepared by grinding the grains down on fine glasspaper. When viewed with a low-

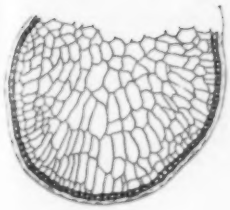

Fig. 1. Transverse section of part of wheat grain, showing outline of endosperm cells

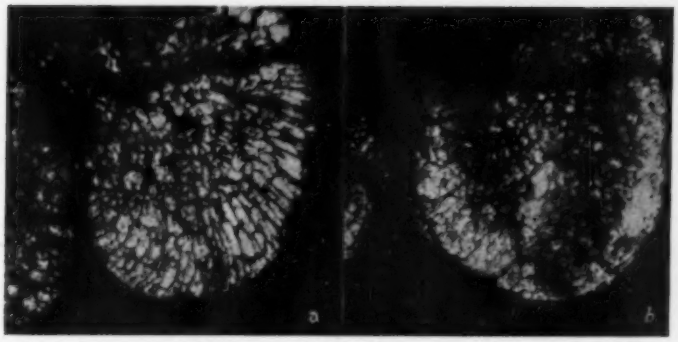

Fig. 2. Section of part of wheat grain after moistening, showing development of cracks: (*a*) hard; (*b*) soft. (× 24)

power microscope by transmitted light, taking precautions to avoid the entry of stray light into the microscope, the translucent endosperm showed no marked structure. When, however, the surface was moistened and allowed to dry for one to two minutes, the strains set up caused the development of fine cracks in the endosperm which were visible as dark lines on the translucent ground. With a hard wheat the pattern formed by these cracks reproduced to a considerable degree that of the cell walls. In a soft wheat, however, the cracks or lines of cleavage were not only much less noticeable but also they showed no similarity to the pattern of the cell walls and in many cases passed through the cells (Figs. 1 and 2).

(2) Wheat grains, either vitreous or mealy in character, were cut transversely across the middle and held firmly in a holder with the cut surface uppermost for observation under a dissecting microscope. Pressure was then applied with the flat side of a scalpel, around the margin of the cut surface, so that the endosperm at the surface broke down. Under these conditions the endosperm of a hard wheat could be seen to fracture along the lines of the cell walls, producing particles—of crystalline appearance if the grain was vitreous—which were predominantly whole single cells or groups of two or more cells. When a soft wheat grain was treated in the same way, however, the endosperm broke down indiscriminately into structureless masses. Further examination showed that in the great majority of cases the lines of cleavage had developed across or through cells, tearing them open and liberating the contents (Fig. 3).

(3) Similar observations were made by a variation of the above procedure. Wheat grains were cut transversely across the middle and a slice (0·5 mm. thick) was cut from the middle portion. Whole slices were not obtained, the dry endosperm shattering readily; but the larger fragments, preferably of endosperm only, were placed between two microscope slides and the two slides pressed together with the fingers. The crushing of the endosperm was observed through a dissecting microscope. Again the hard wheats, unlike the soft wheats, were observed to break up largely into single cells or multiples of cells.

This characteristic breakdown of the hard-wheat endosperm was observed in both vitreous and mealy grains, somewhat more readily in the latter, though the endosperm in these grains is more delicate and pressure must be applied with greater care if the cells are not to be crushed completely.

Yeoman and Scandia were accepted as typical hard and soft wheats; but the observations were extended to the hard Holdfast and Marquis and the soft Bersée and Little Joss. Two hybrids of hard × soft (Holdfast × Squarehead's Master) were examined. One behaved like a typical soft wheat, whereas the other approached the hard wheats in character. Two further examples of hard × soft hybrids (Pilot and Eroica) were examined; both resembled the hard wheats in their behaviour. This classification of these hybrids was in agreement with their milling character. Incidentally, Pilot is one of the few hard wheats which is of poor bread-making quality, so that apparently this quality is not a factor in the differences we have described.

These observations confirm the conclusions of Berliner and Rüter that the feature which differentiates hard wheats from soft is the characteristic way in which, when under pressure, the endosperm tends to fracture along the lines of the cell walls.

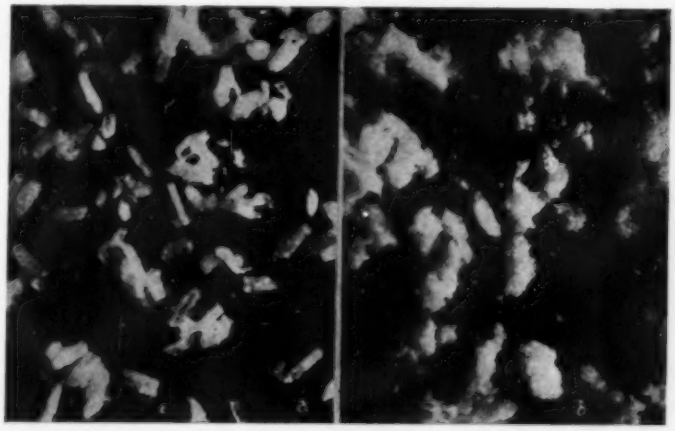

Fig. 3. Particles of wheat endosperm produced by slight pressure: (*a*) hard; (*b*) soft. (× 48)

The structural factors underlying this difference in behaviour are not yet understood.

Berg's hypothesis as to the genetic nature of hardness in wheat has yet to be proved. The use of single grains, as described above, in contrast to milled flour samples, may render examination of this problem more simple, since the classification of hybrid material can be made at a very early stage. If a genetic analysis is successful, then methods of selection readily accessible to plant breeders would presumably become available. We hope to investigate some aspects of this problem further, but in the meantime these observations may be of interest to wheat breeders as offering an early assessment of new hybrids.

[1] Biffen, R. H., *J. Agric. Sci.*, **3**, 86 (1908).
[2] Berg, S. O., *Cereal Chem.*, **24**, 274 (1947).
[3] Greer, E. N., *J. Agric. Sci.*, **39**, 125 (1949).
[4] Berliner, E., and Rüter, R., *Z. gesamte Mühlenwesen*, **5**, 13 (1928); **5**, 105 (1928); **6**, 114 (1929).

THE MAKING OF THE ELEMENTS 97 AND 98

By Prof. F. A. PANETH, F.R.S.

THERE is a tendency to duplication in the history of the discovery of the transuranic elements. In 1940 the first isotopes of the elements 93 (neptunium) and 94 (plutonium) were produced, and four years later the artificial creation of the elements 95 and 96 (americium and curium) was accomplished, though publication of the results had to wait until after the War[1]. Now from the Radiation Laboratory of the University of California comes the news that within the past few months the next two transuranic elements have been made and identified.

The first announcement, released early in January of this year, concerned element 97. S. G. Thompson, A. Ghiorso and G. T. Seaborg, aided by a number of other physicists and chemists and working under the auspices of the U.S. Atomic Energy Commission, had bombarded the isotope of element 95 (americium), of atomic weight 241, with 35-MeV. helium ions accelerated in the California 60-in. cyclotron and thereby obtained a nuclide with a half-life of 4·6 hr. and probable atomic weight 243. It decays by electron capture, with approximately 0·1 per cent α-branching; there seem to be three α-particle groups, that of 6·72 MeV. having the highest energy[4].

The production of element 98, which has just been reported by the same three authors and K. Street, jun., was achieved in an analogous way[2]. By irradiating the isotope of element 96 (curium), of atomic weight 242, in the same cyclotron with helium ions of the same energy, a new nuclide was formed which decays with a half-life of about 45 min., emitting α-particles of energy 7·1 MeV. The possible and, for theoretical reasons, likely decay by electron capture has not yet been observed. The atomic weight should be 244.

That in both cases new radioactive nuclides were obtained is, of course, not sufficient evidence that two new chemical elements have been made; they could well be new isotopes of known ones. Since the quantities produced are far too small for an examination of the characteristic X-ray spectra, the authors had to rely on radiochemical methods for the determination of the places these new nuclides occupy in the natural sequence of elements. But the application of such methods is here beset with great difficulties. The four transuranic elements, 93–96, have been shown to be chemically very similar to each other; this was no surprise to chemists, because so long ago as 1922 Niels Bohr had predicted that after uranium a group of elements should begin, resembling in their close similarity the elements of the rare-earth group. This similarity makes it impossible to prove the presence of a new transuranic element by a qualitative chemical reaction specific for this particular element; exactly as the rare-earths, they show only very small quantitative differences in their behaviour. Fortunately, during the War, new separation methods for such similar elements were developed which are incomparably more efficient than the classical analytical procedure of fractional crystallization; they are based on adsorption and desorption on specially prepared resins and have, among other successes, led to the

Period	Group 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I																	1 H 1·0080	2 He 4·003
II	3 Li 6·940	4 Be 9·02											5 B 10·82	6 C 12·010	7 N 14·008	8 O 16·0000	9 F 19·00	10 Ne 20·183
III	11 Na 22·997	12 Mg 24·32											13 Al 26·97	14 Si 28·06	15 P 30·98	16 S 32·066	17 Cl 35·457	18 A 39·944
IV	19 K 39·096	20 Ca 40·08	21 Sc 45·10	22 Ti 47·90	23 V 50·95	24 Cr 52·01	25 Mn 54·93	26 Fe 55·85	27 Co 58·94	28 Ni 58·69	29 Cu 63·54	30 Zn 65·38	31 Ga 69·72	32 Ge 72·60	33 As 74·91	34 Se 78·96	35 Br 79·916	36 Kr 83·7
V	37 Rb 85·48	38 Sr 87·63	39 Y 88·92	40 Zr 91·22	41 Nb 92·91	42 Mo 95·95	43 Tc 99	44 Ru 101·7	45 Rh 102·91	46 Pd 106·7	47 Ag 107·880	48 Cd 112·41	49 In 114·76	50 Sn 118·70	51 Sb 121·76	52 Te 127·61	53 I 126·92	54 Xe 131·3
VI	55 Cs 132·91	56 Ba 137·36	57–71 Rare Earths†	72 Hf 178·6	73 Ta 180·88	74 W 183·92	75 Re 186·31	76 Os 190·2	77 Ir 193·1	78 Pt 195·23	79 Au 197·2	80 Hg 200·61	81 Tl 204·39	82 Pb 207·21	83 Bi 209·00	84 Po 210	85 At 211	86 Rn 222
VII	87 Fr 223	88 Ra 226·05	89 Ac 227	90 Th 232·12	91 Pa 231	92 U 238·07	93 Np 237	94 Pu 239	95 Am 241	96 Cm 242	97 Bk 243	98 Cf 244						

† Rare earths

VI 57–71	57 La 138·92	58 Ce 140·13	59 Pr 140·92	60 Nd 144·27	61 Pm 147	62 Sm 150·43	63 Eu 152·0	64 Gd 156·9	65 Tb 159·2	66 Dy 162·46	67 Ho 164·90	68 Er 167·2	69 Tm 169·4	70 Yb 173·04	71 Lu 174·99

separation and identification of the last missing rare-earth element, promethium. Seaborg and his colleagues have applied here the same technique which was, however, made more difficult by the small quantities of material and, in the case of element 98, by the short life of the new nuclide. A further complication was the presence of the mother substances, of many million times stronger activity than the new nuclide, from which these new elements had to be cleanly separated before their own activities could be observed.

While on one hand the great chemical similarity between the new elements and those preceding them made their separation laborious, on the other hand it enabled the research workers to foresee the exact places where the elements 97 and 98 ought to appear in a carefully regulated fractionation process, and the success has fully justified their expectation. It is certainly unnecessary to emphasize that years of experience and the skill of a large and highly trained research team under steady leadership were necessary to perform the many operations, from the bombardment of invisible quantities of synthetic americium and curium up to the chemical isolation and radioactive characterization of the two short-lived new elements.

The strict regularity shown by the elements 93–98 when subjected in the tervalent state to fractional adsorption and elution is an experimental confirmation of Bohr's theoretical prediction mentioned above, that the elements following uranium should be very similar to each other; in any representation of the periodic system we must, therefore, avoid allotting to these elements places which would imply that they are higher homologues of rhenium and the elements of the platinum group. Seaborg and those who follow him like to break off the last row of the periodic table at actinium and to write the elements 89–96 (and now to 98) as the group of 'actinides' under the group of 'lanthanides' 57–72. They can point out in favour of this arrangement that in this way probable similarities in the electronic structure of the respective members of the two groups are clearly indicated. However, these similarities, even if present, do not manifest themselves in the chemical behaviour of the first members, and those chemists who want to show above all in the periodic system a grouping according to chemical relationships, hold that the discovery of the transuranium elements does not justify the neglect of the old-established and obvious correspondence between thorium and hafnium, protactinium and tantalum, and uranium and tungsten. They prefer to leave the periodic system up to uranium unchanged, and to put a group of transuranic elements, or 'uranides' as they are sometimes called, at the end of the table.

In the accompanying presentation of the periodic system the close similarity of these elements is indicated by the absence of dividing lines, just as in the group of the lanthanides which, for reasons of economy of space, are written outside the framework of the table and not within period VI, to avoid the interruption of the other periods by too much white paper. In this table are included the symbols of the elements technetium, promethium, astatine, francium, neptunium, plutonium, americium and curium, which last September were officially sanctioned by the International Union of Chemistry. The new symbols 'Bk' and 'Cf' for elements 97 and 98 are also inserted, since there is little doubt that the proposals of their discoverers to name them "berkelium" and "californium", after Berkeley and the University of California, where this excellent work has been carried out, will be accepted.

[1] See, for example, the survey in *Nature*, **159**, 8 (1947).
[2] Thompson, S. G., Ghiorso, A., and Seaborg, G. T., *Phys. Rev.*, 77, 838 (1950).
[3] Office of Public Information, University of California, Release March 17, 1950. *Phys. Rev.* (in the press).

OLIVER HEAVISIDE (1850–1925)

By Eng.-Capt. EDGAR C. SMITH, O.B.E., R.N.

ON May 13 the centenary occurs of the birth of Oliver Heaviside, the British mathematical physicist whose name is familiar to millions by the term 'Heaviside layer'. Heaviside, in an atmosphere of scepticism, unravelled one of the secrets of long-distance telephony, and his work in various branches of electrical science is appreciated by those most capable of judging its importance. Of the man himself, few biographical details have been recorded, for much of his life was passed in seclusion in Devonshire, and he took no part in the proceedings of the societies of which he was a member. Though it is stated he was born in London on May 13, 1850, little has been published of his parents and his education. He was apparently largely self-taught, and for some years had a post with the Great Northern Telegraph Company at Newcastle upon Tyne. At the age of twenty-four, however, increasing deafness made him retire from business life, and he settled in Torquay, which was his home until his death on February 4, 1925, at the age of seventy-four. He was buried in Paignton Churchyard. An obituary appreciation by the late Dr. Alexander Russell was published in *Nature* of February 14, 1925.

Among the correspondents of his later years were Sir Oliver Lodge, Prof. John Perry, Dr. G. F. C. Searle and the distinguished American electrician, Mr. B. A. Behrend. Writing in the *Electrical World* of February 21, 1925, Sir Oliver Lodge said: "Probably no one in his time had an equal grasp of the present and future outcome of Maxwell's theory. He expressed the generation of electric waves in his own style; he treated of the motion of electric charges at different velocities, including those which equalled or even hypothetically surpassed the velocity of light. Everything relating to electrical induction and the energy of electric currents, and the forces and fluxes of energy in the electromagnetic field, the self-induction of wires and the generation of waves was elaborately worked out . . . ". Many of the terms in use to-day were coined by him.

Heaviside's papers were published in the *Philosophical Magazine*, the *Philosophical Transactions* and the *Electrician*. His papers were reprinted in his "Electrical Papers" (1892), published by Macmillan and Co., Ltd., and in three volumes on "Electromagnetic Theory", published in 1893, 1899 and 1912, and reprinted in 1922. A full review of his work was given by Dr. W. E. Sumpner in the twenty-third Kelvin Lecture delivered to the Institution of Electrical Engineers on April 21, 1932.

Though recognition came to Heaviside late in life, he had been elected a fellow of the Royal Society in 1891, and was afterwards elected a fellow of the Institution of Electrical Engineers and an honorary member of the American Academy of Arts and Sciences and of the American Institute of Electrical Engineers. In his tribute to Heaviside, Behrend

wrote: "The war had brought on rapidly rising prices peculiarly hard to bear by the older people. It had dissipated to the four winds domestic servants of any kind. . . . Delicate and sensitive, Heaviside suffered, at first inconvenience, later real want. . . . He lived on alone. He saw reared on his work and genius an industrial and economic edifice of enormous proportions, and he had no share in the rewards and little in the fame. . . ."

When he was seventy-one, the Institution of Electrical Engineers held its jubilee. On the proposal of Sir Oliver Lodge, a special message was sent to Heaviside, and a little later he received the first Faraday Medal founded to mark the occasion of the jubilee of the Institution; this was personally conveyed to Heaviside by the president, the late Mr. J. S. Highfield.

SUBMARINE GRAVITY SURVEY

A BRITISH EXPEDITION IN THE EASTERN MEDITERRANEAN

THE figure of the earth is so nearly an ellipsoid of revolution that people are apt to think that the distance between two places can be calculated exactly, once their latitudes and longitudes are known. This is not so. The actual shape of the mean sea-level surface depends on the distribution of matter within the earth and is appreciably distorted in the vicinity of large masses. A good example is found on Cyprus. It is known from triangulation that Limmasol and Kalokhorio, which lie on the northern and southern shores of the island, are 57 km. apart. Yet the distance between them, as calculated from astronomical observations, is 1·8 km. greater, a difference of approximately 3 per cent. This discrepancy at once suggests that there is an abnormal concentration of high-density material between them. A gravity survey has confirmed this, for large positive anomalies are found almost everywhere on the island. At Agros, which is approximately half-way between Limasol and Kalokhorio, the free air anomaly is + 282 milligals, and after allowing for the attraction of topography, the Bouguer anomaly is found to be + 174 milligals. It is estimated, however, that even these large positive anomalies would only account for about half the observed difference in the deflexions of the vertical: presumably the rest is due to mass deficiencies below the sea farther to the north or south.

The example just given is abnormal, but it is a striking reminder that the fundamental problem of geodesy, the determination of the shape of the earth, is still far from solved. It has been shown by Stokes that the shape of the geoid can be calculated if gravity is known all over the earth. Unfortunately, this method can only be applied very approximately at present, owing to scarcity of data, especially over the oceans. At sea, except in shallow water, the only practical method of measuring gravity with sufficient accuracy is to make observations in a submerged submarine. Such experiments demand close collaboration between naval and scientific personnel. In Great Britain, the Defence Services Research Facilities Committee of the Royal Society provides the necessary liaison. Since the War, two expeditions have been made in the vicinity of the British Isles. The results of the first, made in 1946, have recently been published, and technical details of the second are also available. A third expedition is now planned in the Eastern Mediterranean and is due to sail from Malta in the middle of May. The necessary funds are being provided by a special grant from the Royal Society, and the Royal Navy is giving wholehearted co-operation. The technical arrangements have been made by the Department of Geodesy and Geophysics in the University of Cambridge, with the generous assistance of the Danish Geodetic Institutes.

The Western Mediterranean has already been studied by the French and Italians, and so, when the British results are known, a fairly complete general picture of the gravitational field of the whole Mediterranean Basin will be available. Quite apart from the geodetic importance of these observations, it should be possible to draw some most interesting geological conclusions. The Mediterranean is generally supposed to be that portion of the Tethys Sea remaining after the great earth movements, which formed the Alps and other folded mountains in southern Europe and Asia Minor, had subsided. But even now the crust of the earth is not quiescent, for volcanic eruptions and earthquakes are still experienced. A study of the gravitational field may well throw light on the cause of these phenomena. Particular points will also be examined. Comparative surveys around Pantelleria and Malta may show whether or not the latter is of volcanic origin. The structural relationship between the islands of Crete and Cyprus and the Taurus Mountains on the Turkish mainland should be plainly revealed if the large anomalies mentioned earlier are found to extend out to sea. Measurements over the Nile Delta and among the Dodecanese Islands will show how nearly these regions are in isostatic equilibrium. In addition, it is hoped to connect up the results of earlier surveys by making special observations, both at sea and in harbours, and to carry out an extensive programme of echo sounding.

The survey itself will last about twelve weeks, during which about a hundred and twenty gravity determinations will be made; but it will be several months before all the records are finally measured and the results known. More accurate estimates of relative deflexions of the vertical can then be made and tentative geological conclusions drawn. These may require revision as further data become available; but the actual gravity measurements and soundings will be of permanent value. Geophysical methods are rapidly becoming of great assistance to geologists, and in areas such as the Eastern Mediterranean, where sediments obscure the underlying rocks, they may well prove of major importance. The results of the proposed British submarine gravity survey will therefore be awaited with great interest.

B. C. BROWNE

OBITUARIES

Prof. J. A. Crowther

BY the death, on March 25, of James Arnold Crowther, we have lost another of the remaining living links with the Cavendish Laboratory of J. J. Thomson's time. It was in those days—which now seem both so recent and so distant—that Crowther, after a brilliant undergraduate career (1903–6) at Cambridge, made his first indelible mark on physics history with his important investigations into the

scattering of X-rays and the properties of β-rays. He continued his researches first as Mackinnon Student of the Royal Society, later as Fellow of St. John's, and started his teaching career as demonstrator and lecturer in the Cavendish, a post which he held until 1924.

In the early days of the First World War he was associated with Alfred Robb in running an X-ray laboratory to help Addenbrooke's Hospital with the many war casualties pouring into Cambridge. This early experience, when X-ray facilities for radiological diagnosis were practically non-existent, no doubt deflected part of his research interests into the field of medical radiology, and one of his books was written on this subject; while his editorship of "The Handbook of Industrial Radiology" proved his realization of the import of X-ray radiological techniques in industry. He was lecturer in medical radiology in the University of Cambridge during 1921–24, and he became president of the British Institute of Radiology in 1936.

Crowther held the chair of physics in the University of Reading during 1924–46, when he retired as professor emeritus. During his tenure of the chair at this young and expanding university, Crowther spread his abundant energies in wide and influential spheres. His quick and ready brain, coupled with a flowing, happy pen, gave scope to his expository powers in a number of valuable text-books. The best known to students perhaps is "Ions, Electrons and Ionising Radiations", kept up to date in a series of editions, and deservedly popular with many generations of young students. A number of other books stand to his credit and will be a very real monument to his memory.

A powerful influence outside that of the written word flowed from his connexion with the Institute of Physics. A founder Fellow, he served continuously on its Board for twenty years, until his death, and was honorary secretary during 1932–46. During this period the Institute increased its membership and importance by leaps and bounds, due in great measure to his enthusiasm and self-sacrifice in its service. It was at the end of this period, 1944–46, that he became vice-chairman of the Parliamentary Science Committee.

Crowther was a Yorkshireman, born on August 28, 1883, in Sheffield, where he went as a boy to the Royal Grammar School. He had little of the traditional bluntness of the North—his was the gentle, kindly outlook of the true student—and those privileged to see behind the shy exterior always felt the better for the glimpses. He enjoyed a happy domestic life, and he leaves a widow and two sons.

R. WHIDDINGTON

Prof. Thomas Hugh Milroy

DR. T. H. MILROY, who died on March 20 at the age of eighty at his home in North Berwick, was the eldest son of John Milroy of Kirkcowan, Wigtownshire. He was educated in Edinburgh, Berlin and Marburg, and after a period as lecturer in physiological chemistry and assistant to the professor of physiology at Edinburgh, he was appointed to the Dunville chair of physiology at Queen's University, Belfast, a post which he held from 1902 until his retirement in 1935.

This was a period of rapid progress in the Belfast Medical School. Before the foundation of the Dunville chair, physiology had been taught by the professor of anatomy. Milroy's predecessor was the first occupant of the separate chair and had held it for only a short time. The development of the new Physiology Department depended, therefore, almost entirely on Milroy; and it is a monument to his successful efforts. Among the duties of the holder of the Dunville chair in its early days was the delivery of a series of public lectures on human physiology. Milroy's lucid and interesting addresses attracted crowded audiences.

His teaching in the medical school was equally effective; not a few of his former students now hold chairs and other important positions in Great Britain and elsewhere. For many years his chief research interests lay in the physical chemistry of blood and the physiology of muscle, and he published a number of important papers on both these subjects. His profound knowledge of physiology and physiological literature was always at the service of other workers. With his brother, the late Prof. J. A. Milroy, he published a "Textbook of Practical Physiological Chemistry". This notable book contains much information not to be found in any similar work; and the methods described in it were tested personally before they were included.

Milroy had no undue regard for degrees and distinctions. Honours, which he doubtless appreciated but which caused no change in his unassuming disposition, came to him from various sources. He was an honorary D.Sc. of Belfast and of the National University of Ireland, an honorary M.D. of the University of Dublin, and an honorary LL.D. of Edinburgh.

He was a man of fine character with a keen and critical mind. He took a kindly interest in the welfare of his students, many of whom he helped by every means in his power. He enjoyed the esteem and affection of his colleagues. He and his brother occupied for years a unique place in the life of Queen's University and formed many lasting friendships in Belfast. Milroy's decision to return to Scotland when he retired was greatly regretted by his Ulster friends, who have heard with deep sorrow of his sudden death.

Prof. W. J. Dakin

THE death of Prof. W. J. Dakin occurred at Sydney on April 2 after a long and tragically hopeless illness which began on the eve of his retirement. He held the Challis chair of zoology in the University of Sydney from 1928 until two years ago.

William John Dakin was born at Liverpool in 1883 and after an unusually distinguished student career at the University of Liverpool he proceeded to further postgraduate studies at Kiel. He became an 1851 Exhibitioner, and working at Heligoland, Norway, Naples and at home made fundamental contributions in the physiology of marine animals. During the period 1909–13 he held lectureships at Belfast, Liverpool and University College, London, after which he became professor of biology in the University of Western Australia. He held the D.Sc. degrees of Liverpool and the University of Western Australia, and in 1920 was appointed to the zoology chair in the Liverpool department where he received his early scientific education. From there he went to take up the Sydney appointment that he held until shortly before his death.

Dakin's experimental work on the oxygen requirements, nitrogen absorption and osmotic and reproductive phenomena in marine animals in Europe is well known, and he showed no diminution in productivity when he went to Australia. At Sydney he established a marine biological station which, at the same time, resulted in a perhaps unfortunate lopsidedness in the Department there. His work of this period turned largely toward the ecology of marine and lacustrine fauna, and much of his most valuable results appeared in the monumental "Plankton of the Australian Coastal Waters" (with A. N. Colfax) published by the University. It was unfortunate that an appreciable proportion of the edition was lost by enemy action at sea and so did not reach Great Britain. One of the many admirable productions of Dakin's restless activity was his translation from the German of Goldschmidt's "Mechanism and Physiology of Sex Determination". Less well known, probably, was his war service to the Commonwealth in civil camouflage during the dark period when, with most of the Australian forces absent in other theatres, Northern Australia was severely bombed and invasion seemed imminent. For this work Dakin never received adequate recognition. Last year, however, he was awarded the Mueller Medal for distinguished service to Australian science.

Among other important works, Dakin wrote a textbook, "The Elements of General Zoology", that is notable for its physiological approach, and in 1935 there appeared "Whaleman Adventurers"—a remarkably fine and readable account of the history and practice of whaling in southern seas. While at Sydney, Dakin reached a wide public in a series of fortnightly broadcasts called "Science in the News", and his students found him a brilliant lecturer though many regretted that they did not hear him more often. He possessed, and demanded of his pupils, a high standard of scholarship, and his research students in marine ecology and colleagues in two continents will remember him with admiration and gratitude. A. J. MARSHALL

WE regret to announce the following deaths:

Mr. G. H. Nash, C.B.E., a director during 1927–38 of Standard Telephones and Cables, Ltd., known for his work on the seismophone and the hydrophone, on April 7, aged sixty-nine.

Prof. G. W. Robinson, F.R.S., professor of agricultural chemistry in the University College of North Wales, Bangor, on May 6, aged sixty-one.

Dr. Herman Shaw, director of the Science Museum, South Kensington, on May 4, aged fifty-eight.

NEWS and VIEWS

The National Institute for Medical Research: Opening by H.M. the King

ON the afternoon of May 5, the ceremony of opening the new buildings at Mill Hill of the National Institute for Medical Research (see p. 744 of this issue) was performed by H.M. the King, who was accompanied by the Queen. Lord Addison, Lord Privy Seal and chairman of the Medical Research Council, read an address of welcome in the Fletcher Memorial Hall of the Institute, to which the King replied: "This new building marks yet one more advance in man's fight against disease and in his struggle to bring a healthier and fuller life to each of us. The opening of this building is a great encouragement because it shows that, in spite of the serious setbacks of war, the search for new knowledge for the benefit of humanity persists, and by its enthusiasm surmounts all difficulties. The Medical Research Council, in providing this centre, show that they are preparing for still greater efforts and progress in the future. . . . The work of the Institute exemplifies that spirit which inspires the State and science to work together for the health and happiness of mankind. The results of this union are available to all without distinction of race, colour, or creed. . . . I congratulate the Institute on what it has already done and on the world-wide reputation for distinguished scientific work which it has long established. . . ." After declaring the Institute open, the King and Queen, accompanied by Sir Charles Harington, director of the Institute, made a tour of the buildings and inspected the work of the various departments.

Geological Survey of Great Britain: Dr. W. F. P. McLintock

IT has been recently announced that Dr. W. F. P. McLintock, director of the Geological Survey of Great Britain since 1945, is to retire in the autumn. Educated at the University of Edinburgh, Dr. McLintock became assistant curator of the Museum of Practical Geology (which is the museum of the Geological Survey) in 1907; he then spent some ten years in charge of the Geology Department at the Royal Scottish Museum, returning to the Museum of Practical Geology as curator in 1921. His more important personal contributions to geology relate to mineralogical and geophysical subjects, and he has done much to establish geophysical study as a branch of Geological Survey activity. His service as curator of the Museum has covered the building and arranging of the new premises in South Kensington, London; this 'shop window' of the Geological Survey has probably done more than anything else in recent years to widen public interest in geology and to display the ways in which geological science is contributing to the economic life of Great Britain. From 1937 Dr. McLintock acted as deputy to his predecessor, Sir Edward Bailey, and, on becoming director at the end of the War, he vigorously set out to re-establish the Museum and to organise the Geological Survey to deal with its rapidly expanding responsibilities.

Prof. W. J. Pugh, O.B.E.

PROF. W. J. PUGH, who will succeed Dr. McClintock, received his training at the University College of Wales, Aberystwyth. During the First World War he was commissioned in the Royal Welch Fusiliers and was engaged in air-photography work with the Second and Fourth Armies and later with the Army of the Rhine. For his services he was awarded the O.B.E. and the Croix de Guerre and was twice mentioned in dispatches. Afterwards he received a course of training in surveying for service with a boundary commission; but in 1919 he was elected to the chair of geology at Aberystwyth. In 1930, Prof.

Pugh was appointed to the chair at the Victoria University of Manchester, and for many years he has taken a prominent part in university administration in the office of deputy vice-chancellor. In 1948 he served on a commission appointed to consider proposals for a University of Malaya, and in 1949 he was president of Section C of the British Association. He has served on the Council of the Geological Society during 1933–38 and from 1947 to date and was a vice-president during 1936–38. Prof. Pugh's researches and published works have been mainly on the Lower Palæozoic rocks of central and north Wales, and in recent years he has been engaged, in collaboration with Prof. O. T. Jones, in a detailed survey on the 25-inch scale of the Ordovician rocks of central Wales near Builth and Llandrindod. This is probably the largest area anywhere to be surveyed geologically on this scale.

Sir Wilson Jameson, G.B.E., K.C.B.

THE office of chief medical officer of the Ministries of Health and Education follows in direct line of descent that of Medical Officer of the Privy Council created in 1858 and first filled by Sir John Simon. Since the Ministry of Health was formed in 1919 there have been only three chief medical officers: Sir George Newman, Sir Arthur MacNalty and Sir Wilson Jameson, the last of whom reached the retirement age on May 11. He is a graduate of Aberdeen, and his main work before he became a Civil Servant had been as dean of, and professor of public health in, the London School of Hygiene and Tropical Medicine. Following a short period as medical adviser to the Colonial Office, he was appointed to his present position in 1940. He was faced at once with problems of great magnitude, as failure in the health services would have had a far-reaching effect on the successful conduct of the War. London and other large industrial cities were being subjected to heavy aerial bombardment, shelter life carried the risk of grave epidemic disease, the evacuation of children presented many medical problems, and added to all this was the ever-present threat to our food supply. He gave sound advice on all these matters. He inaugurated the highly successful national campaign for immunization against diphtheria. His broadcasts on this subject made his name a household word. He broke the taboo against the mention of venereal disease in newspapers and on the radio. His interest in medical education led to the appointment of the Goodenough Committee on this subject and the subsequent adoption of its main recommendations by the Government, with the consequent great increase in the money made available to, and by, the University Grants Committee. He played an active part in the inauguration of the National Health Service, and though opinions differ on the details of the scheme there is no dispute as to the excellence of the principles which underlie it. It is no doubt due to Sir Wilson's advocacy that the teaching hospitals in England and Wales have been allowed to retain their endowments and that each has its own Board of Governors responsible direct to the Ministry of Health. Among Sir Wilson's many honours are G.B.E., K.C.B., Harveian Orator of the Royal College of Physicians, Buchanan Medal of the Royal Society, a Lasker Award of the American Public Health Association, and many honorary degrees. His departure from the Ministries of Health and Education will be greatly regretted. The seeds which he has sown there will bear fruit in plenty for many years to come. His wealth of experience is such that the King Edward Fund is to be congratulated warmly on having secured his part-time services.

Systematic Botany at Kew

THE Herbarium and Library of the Royal Botanic Gardens, Kew, were open to members of scientific societies on May 5 and to students from universities and colleges on May 6. A large series of exhibits and demonstrations were arranged by members of the Kew staff to illustrate two main themes: research work in progress at Kew, and the methods and principles of plant taxonomy. The ground-floors of three wings of the Herbarium were occupied by beautifully arranged specimens of living and preserved plants, drawings, paintings, diagrams and photographs. In the Library there were displayed selected books and periodicals illustrating Kew publications and the use to which a specialized library is put in taxonomic research.

On May 5, Dr. N. L. Bor, assistant director, and Dr. W. B. Turrill, keeper of the Herbarium and Library, welcomed visitors and explained the main purposes of the exhibition. On May 6, Sir Edward Salisbury, director, opened the proceedings with an account of the history of Kew as a scientific establishment and of the researches now being carried out in the several departments. More than 450 guests were received on the two days. Among special exhibits were those illustrating the great range of leaf structure in grasses, the evolution of the genus *Rhododendron*, new or interesting South American plants, the flora of Iraq, geocarpy, a new classification of the sedges, varieties of ivy, variation in cedars, monographic work on Basidiomycetes and on West Indian Fungi, methods of determining Fungi, ferns of special interest, Australian Gleicheniaceæ, tropical Algæ, seeds of economic interest, and different kinds of manna.

A demonstration of the "birth of a family" attracted much attention. It illustrated the affinities of a tall forest tree, recently collected, by a member of the Kew staff, in the Cameroons. This represents an entirely new family which it is difficult to place satisfactorily in existing systems of classification. Prominence was given to the great new work on the flora of Tropical East Africa which has been commenced at Kew for the Colonial Office. This is to be an illustrated systematic account of all the known vascular plants from Uganda, Kenya, Tanganyika and Zanzibar—an estimated total of 10,000–12,000 species. It will take many years to complete and will involve much investigation both at Kew and in East Africa. One wing of the Herbarium was occupied by a unique series of exhibits designed to demonstrate to students and teachers the practical methods and theoretical principles of taxonomic research. These were shown to involve or include the assembly of material for study, the recognition of characters of systematic value, the investigation of taxonomic groups, and various problems encountered in the course of research.

Electrical Machine Analysis

A COLLOQUIUM on electrical machine analysis was held in the Electrical Engineering Department of the Imperial College of Science and Technology, London, during April 3–4. It was attended by some forty engineers, drawn from industry, the universities and technical colleges, who met to discuss progress in the development of methods of analysis for determ-

ining the performance of electrical machines. The first session, under the chairmanship of Prof. Willis Jackson, was opened by Prof. M. G. Say and Mr. S. Neville, and was devoted to a review of present-day methods of predetermining the performance of electrical machines. The second session dealt with the transient performance of synchronous machines and was opened by Mr. B. Adkins and Prof. G. H. Rawcliffe. Mr. Adkins demonstrated a method of setting up differential equations of salient-pole synchronous machines, using the two-reaction theory, and demonstrated its value by developing the equations for the various reactances and time-constants that are used in determining steady-state and transient performance. The use of matrix methods for machine analysis, introduced at the third session by Mr. M. W. Humphrey Davies, was developed by Mr. W. J. Gibbs into a powerful technique for solving practical problems on most types of electrical machine, including A.C. commutator and D.C. cross-field machines. The final discussion was opened by Mr. L. D. Anscombe, who stressed the need for better definitions of the parameters used in practical calculations of machine performance.

Nutritional Levels of the Population of the World

FOUR meetings on the subject of "Man and his Foods" were held in Montevideo, Lima, Quito and Santiago (Chile) during the summer of 1949. The Centre of Scientific Co-operation of Latin America, Bulevar Artigas 1320, Montevideo, organised these meetings and has published a report under the title "L'Homme et ses Aliments". Much of the material is concerned with giving figures for the present nutritional state of the world's population and of expected future trends in the size of the population and its nutritional demands. This material has already been published by other bodies of the United Nations Organisation. Since the meetings took place in four different countries, there is naturally a good deal of repetition in the presentation of the facts. Brief contributions by Boerger and Guzman Barron do, however, refer to the part that may be played by the Continent of South America in increasing the world supply of foods. It is emphasized that, though there are considerable possibilities of increased food production in South America, the nutritional level of its inhabitants requires raising before any substantial contribution can be made towards the deficits of other continents.

Grass Drying

A USEFUL addition to periodical literature has recently appeared under the title "The Green Crop Dryers Research Association Year Book 1949". It contains twenty-eight articles dealing with all aspects of grass drying as at present practised in Great Britain, written by scientific experts and agricultural pioneers. Whether grass drying will in future come to occupy an important place in British agricultural economy will depend largely on national policy in regard to imports and prices of the standard concentrated foods, and also on technical economies in what is still a relatively novel process. It is these technical problems which are mainly discussed: the growing and saving of the crop, the types of dryers at present available, the composition of dried grass, and the storage and feeding of the product. A handy appendix lists the members of the county agricultural executive committees, the regional directors and grassland officers of the National Agricultural Advisory Service and similar information which is often troublesome to find. The advertisement pages cover a wide range of implements and machines relating to the production of dried grass. The book is published by the *Farmers Weekly*.

The Black Redstart Inquiry

AN article by R. S. R. Fitter in *British Birds* describes the results obtained during the black redstart inquiry for 1948 (**42**, No. 7; July 1949). Judged by the total number of birds known to have bred, 1948 was the best year the black redstart (*Phœnicurus ochrurus*) has had in England yet; the bird was also more widespread in the breeding season than in any year since 1943. At least twenty-six, and probably twenty-nine, birds are known to have bred, and some fourteen other singing males were present in the breeding season. The marked tendency for small breeding populations to become established in a few localities is again recorded. In the City of London, for example, and at Dover, Hastings and Pett Level, 1948 was at least the sixth successive year in which either one or more pairs had bred or one or more singing males had been present. The populations at one time established at Wembley, Cambridge and Lowestoft, however, have died out.

A notable feature of 1948 was the number of localities where birds were reported in July and August, well before the normal arrival date of Continental immigrants, which is from mid-September in small numbers with the main body arriving in October and November. Such post-breeding-season wanderers were seen at Eastbourne (Sussex), in July, and at Swanage (Dorset), Crawley (Sussex), Elmley Ferry (Kent) and Blakeney Point (Norfolk) in August. The article contains a detailed list of the number of birds recorded in the various counties; the inquiry is to be continued and observers' reports are invited.

Setting up a New Government Department

IN the third of the occasional papers which have been prepared by the British Institute of Management, Mr. H. V. Rhodes, director of establishments and organisation, Ministry of National Insurance, gives a detailed account of the setting up of the Ministry and how the complex schemes of social welfare which are its particular charge were successfully launched. The necessity for a 'human' attitude towards the public was insisted on from the beginning. Among other instructions given to the staff was the necessity of foregoing Civil Service jargon when writing to members of the public, the need for informality without effusiveness and fitting the style of the reply to the recipient. Having discussed such questions as accommodation, the general programme, the taking over of the approved societies and the training scheme, Mr. Rhodes concludes by stressing the importance of having an initial framework, the desirability of spreading planning among the top people, and, above all, the realization that it is the men and women charged with the setting up of the new department that really matter rather than abstract conceptions or rules of any kind.

National Peking University: Semi-Centennial Volume

IT is a pleasure to record the receipt of a copy of the National Peking University Semi-Centennial Volume, Mathematical, Physical and Biological

series (pp. 216+11 plates; Peking: University Press, 1948), both because contacts between the Chinese universities and Great Britain are so very few these days, and because the production of so excellent a volume during the difficult times that China has been experiencing deserves the highest commendation. The volume contains nineteen scientific articles, the authors of which either have been, or are still, connected with the National University. These include contributions from the Departments of Botany, Chemistry, Mathematics, Physics and Zoology.

A method of producing and testing Wollaston wires is described by C. T. Tan and K. T. Chao. The results of cloud-chamber experiments on the absorption of slow mesons by thin aluminium, iron and lead foils are given and discussed by W. Y. Chang, of the Palmer Physical Laboratory, Princeton, New Jersey. These indicate that the interaction between a meson at sea-level and a nucleon of matter is very weak. The lecture delivered by Prof. Tsing-Lien Chang, professor of chemistry in Tsing Hua University, Peiping, in commemoration of the National University anniversary on December 17, 1948, is printed on pp. 129–142. The series of experiments on heavy water which Prof. Chang and co-workers have been carrying out since 1935 are briefly reviewed (see *Nature*, May 7, 1949, p. 737). Fourier series, Hermitian forms, three-dimensional rotations, *S*-matrices and Heisenberg's theory of superconductivity are some of the subjects of the mathematical and theoretical physics articles. All the papers but one are in English—the exception being in German.

Society for General Microbiology: Officers for 1950–51

At the annual general meeting of the Society for General Microbiology, held at the Royal Institution on April 5, the following were appointed officers for 1950–51: *President*, Prof. J. W. McLeod; *Joint Honorary Secretaries*, Dr. J. G. Davis (*general*) and Dr. W. E. van Heyningen (*meetings*); *Treasurer*, Mr. H. J. Bunker; *Committee*, Dr. L. A. Allen, Dr. C. H. Andrewes, Mr. F. C. Bawden, Dr. P. W. Brian, Prof. A. W. Downie, Dr. D. W. Henderson, Dr. Betty C. Hobbs, Dr. R. Lovell, Prof. H. B. Maitland, Mr. H. Proom, Dr. P. M. Frances Shattock, Prof. Wilson Smith, Dr. D. D. Woods, Sir Alexander Fleming (representing the International Association of Microbiologists), and Dr. B. C. J. G. Knight and Dr. A. A. Miles (*editors*). Information about the Society can be obtained from the General Secretary, 35 Villiers Road, Southall, Middlesex.

Institute of Industrial Administration: Summer School

The fourth annual residential summer school of the Institute of Industrial Administration will be held in Oriel College, Oxford, during July 15–22. The theme will be general management and will consist of an examination of the factors involved in general management and of the means whereby managerial effectiveness may be increased; the factors will be dealt with under the following headings: work involved, intellectual and human attributes, practical equipment, advancement of standards, and implementation. Further details can be obtained from the Education Secretary, I.I.A., Management House, 8 Hill Street, London, W.1.

Symposium on Information Theory

A Symposium on Information Theory is to be held in the rooms of the Royal Society during September 26–29. The programme will discuss, in particular, the recent work of Dr. C. Shannon, of the Bell Telephone Laboratories, who will himself present two papers, and will be of interest to mathematicians, physiologists and communication engineers. Those wishing to attend are asked to write to Prof. Willis Jackson, Electrical Engineering Department, Imperial College of Science and Technology, London, S.W.7.

Symposium on Agricultural Genetics

The Italian National Council of Research and the Italian Society of Genetics and Eugenics are organising a symposium on agricultural genetics, to be held in Rieti (the birthplace of M. T. Varrone) during May 30–June 2. The first day will consist of papers and discussion on the general theme, and the three succeeding days will be devoted respectively to the application of genetics to the breeding of wheat, trees (fruit, olive and vine) and forage plants. The symposium will have an international background in that a number of foreign authorities will be participating. Further information can be obtained from the Segretario del Convegno di Genetica agraria, Camera di Commercio, Rieti, or from Prof. Carlo Jucci, Centre of Genetics of the National Council of Research, University of Pavia.

Commemorative Symposium on Radioactivity

In commemoration of the discovery of radium in December 1898 by Pierre and Marie Curie, three colloquia on radiophysics, radiochemistry and radiobiology, respectively, will take place in the École Supérieure de Physique et de Chimie Industrielles, Paris, during July 17–19. The colloquia will be devoted principally to the presentation and discussion of experimental results and original theories on the following subjects: radiation in liquids; chemical competition in irradiated media (protection effect); lesions produced by radiation. Further details can be obtained from M. Georges Champetier, École Supérieure de Physique et de Chimie Industrielles, 10 rue Vauquelin, Paris 5e.

Announcements

The Gold Medal for 1950 of the Royal Astronomical Society has been awarded to Prof. Joel Stebbins, of the Lick Observatory, University of California, for his development of physical methods in astronomical photometry and for the results obtained by the use of those methods. Prof. Stebbins will deliver the George Darwin Lecture of the Society on October 13, taking as his subject "The Electrical Photometry of Stars and Nebulæ".

The Gold Medal of the Institution of Mining and Metallurgy, the highest distinction which the Council has power to grant, has been awarded to Mr. Robert Annan, past-president of the Institution and chairman of New Consolidated Gold Fields, Ltd., in recognition of his distinguished services to the mining industry and the mining profession.

H.R.H. The Duchess of Kent will open the new laboratories of the British Leather Manufacturers' Research Association at Milton Park, Egham, Surrey, on May 22.

HUMAN DESOXYPENTOSE NUCLEIC ACID

Isolation of Desoxypentose Nucleic Acid from Human Sperm

WE believe that the procedure described here has led for the first time to the isolation of desoxypentose nucleic acid from human sperm. The preparations exhibited a high degree of polymerization.

The starting material consisted of pooled fresh semen from healthy donors. All samples were normal with respect to volume and viscosity and to the concentration, morphology and motility of the spermatozoa; they were frozen immediately after collection and stored at −15°.

In a typical experiment the spermatozoa from 360 c.c. of semen were separated in a refrigerated centrifuge and washed four times with an ice-cold mixture of 0·14 *M* sodium chloride and 0·1 *M* sodium citrate (5 : 1; *p*H 7·4) and once with ethyl alcohol. The sediment, following extraction with ethanol – ether (1 : 4), weighed 940 mgm. It was suspended in 28 c.c. of the sodium chloride – citrate mixture and crushed in the cold, the suspension being passed through a bacterial mill (Unicam, Cambridge) for 3 hr. The residue, separated by centrifugation, was suspended in 10 c.c. of a solution (*p*H 7·2) of 30 mgm. of crystalline trypsin (free of desoxyribonuclease) in 0·14 *M* sodium chloride–0·1 *M* sodium citrate (30 : 1) and the mixture kept for 1 hr. at 30°. The addition of 2 volumes of ethanol to the somewhat viscous supernatant, resulting from the centrifugation of the digestion mixture, produced white threads which were lifted, washed with 73 per cent ethanol, well drained, and preserved in 95 per cent ethanol. The residue from the tryptic digestion was again treated with trypsin and the nucleic acid fibres were isolated as described before. Between four and eight extractions were necessary for the removal of the bulk of the desoxypentose nucleic acid.

The solution of the combined threads in 23 c.c. of *M* sodium chloride was freed of protein by repeated treatment with chloroform – octanol (9 : 1)[1] in a high-speed mixer. The desoxypentose nucleic acid was precipitated with 2 volumes of ethanol, and the threads were spooled on a rod and washed thoroughly with 73 per cent ethanol. (An additional quantity of fibres could be obtained by reworking the granular precipitates remaining in the various alcoholic mother liquors[2].) A portion of this preparation, washed with ethanol – ether and dried in air, was retained for physical measurements; the rest was dissolved in water, dialysed with rocking against tap water and repeated changes of ice-cold distilled water, and recovered by the evaporation of the frozen solution in a vacuum.

The total yield of sodium desoxypentose nucleate, which formed a voluminous white felt, was 78 mgm. Analysis showed it to contain nitrogen (Dumas) 16·0, phosphorus 8·9 per cent. When assayed against standard preparations of calf thymus desoxyribonucleic acid[3] and yeast ribonucleic acid[4], it was found to correspond to 101·5 per cent of the first and to less than 2 per cent of the second substance.

Viscosity and ultracentrifuge studies were carried out on an air-dried preparation. The specific viscosity of a 0·135 per cent solution in distilled water was $\eta_{sp} = 7·0$. The examination of the nucleic acid in an air-driven vacuum ultracentrifuge, for which we are greatly indebted to Dr. D. H. Moore, showed it to sediment with an extremely sharp boundary. For a 0·22 per cent solution in 0·2 *M* sodium chloride, a sedimentation constant $s_{20} = 5·7\,S$ was found, resembling the value given by an undegraded specimen of calf thymus desoxyribonucleic acid at a similar concentration[5].

It might be mentioned that fresh seminal fluid has been found to contain a desoxypentose nuclease having a depolymerizing action. When assayed by a procedure described previously[6], it had an activity of 15–25 desoxypentose nuclease units per c.c.

A full account of this work, which was supported by a research grant from the United States Public Health Service, will be presented later.

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Composition of Human Desoxypentose Nucleic Acid

IT has been found in this laboratory that the desoxyribose nucleic acid from calf thymus appears to be identical with that of ox spleen with respect to the proportions of the constituent purines and pyrimidines, which, however, deviate very significantly from those required by the 'tetranucleotide' hypothesis; but that the proportions in which the same constituents occur in the corresponding desoxyribose nucleic acids of yeast and of avian tubercle bacilli are entirely different[1,2]. The concept, based on these findings, that desoxypentose nucleic acids are specific in their composition for the species from which they are derived, comparable in this respect to the proteins, prompted, of course, a search for additional evidence, especially among more closely related species.

In the present instance the composition of several highly polymerized desoxypentose nucleic acid specimens of human origin is compared with that of similar preparations from ox tissues which were discussed previously[1]. The following sources served for the isolation of the desoxypentose nucleic acid of man: sperm, thymus, liver and liver carcinoma (metastatic from the sigmoid colon).

The preparation from human sperm is described in the preceding communication. The desoxypentose nucleic acid of thymus was isolated from 26 gm. of pooled autopsy material (mostly from prematurely or stillborn infants). The isolation procedures essentially followed previously published methods[3,4]. The sodium desoxypentose nucleate from thymus was found on analysis to contain 14·3 per cent nitrogen and 8·9 per cent phosphorus, and yielded, as did all other preparations discussed here, very viscous solutions in water. A detailed description of the

isolation of the nucleic acids of normal and carcinomatous liver and of their composition will be reserved for the full account of this work that will appear elsewhere.

The study of the purine and pyrimidine composition of the nucleic acids was carried out by the procedures developed in this laboratory[1,5,6]. One simplification, permitting the use of even smaller nucleic acid samples for a complete analysis, consisted in the quantitative determination of total phosphorus in aliquots of the hydrolysis fluids, both those serving for the estimations of purines and of pyrimidines. This made it possible to determine the molar ratio of nitrogenous constituent to phosphorus without the prerequisite dilution of the hydrolysis mixture to an exact volume[6].

The results are summarized in the accompanying table, which represents the averages of a number of individual hydrolysis experiments.

Desoxypentose nucleic acid	Mole per mole P				Recovery in per cent of nucleic acid P
	Adenine	Guanine	Cytosine	Thymine	
Human sperm, Preparation 1	0·29	0·18	0·18	0·31	96
Human sperm, Preparation 2	0·27	0·17	0·18	0·30	92
Human thymus	0·22	0·19	0·16	0·28	91

The adenine/guanine ratio for the desoxypentose nucleic acids from human sperm and thymus was $1{\cdot}56 \pm 0{\cdot}008$; the corresponding ratio for calf thymus and ox spleen[1] was $1{\cdot}26 \pm 0{\cdot}015$: a difference shown by statistical analysis to be highly significant. When whole defatted human spermatozoa were, after being washed with cold 10 per cent trichloroacetic acid, extracted with hot 5 per cent trichloroacetic acid[7], the adenine/guanine ratio found for this extract was practically the same as in the isolated nucleic acid, namely, 1·53. The desoxypentose nucleic acids isolated from human liver and from human liver carcinoma both gave adenine/guanine ratios of 1·5.

Similarly, significant differences were exhibited by the pyrimidines. Human desoxypentose nucleic acid had a thymine/cytosine ratio of $1{\cdot}75 \pm 0{\cdot}03$; that of ox desoxyribonucleic acid was $1{\cdot}43 \pm 0{\cdot}03$.

The desoxypentose nucleic acids extracted from the tissues of man and of ox thus appear to be different substances or mixtures of closely related substances of a composition constant for different organs of the same species and characteristic of the species. Human desoxypentose nucleic acid showed an even greater divergence from equimolar proportions of its nitrogenous constituents than did that of the ox; it contained much more adenine in relation to guanine and much more thymine in relation to cytosine. But it is noteworthy, though possibly no more than accidental, that in all desoxypentose nucleic acids examined thus far the molar ratios of total purines to total pyrimidines were not far from 1. More should not be read into these figures. Whether the cell contains only one desoxypentose nucleic acid, or many, cannot yet be decided. Recent results obtained in this laboratory[8] could, in fact, be interpreted as indicating the existence in the same cell of more than one desoxypentose nucleic acid. However, if a diversity of this type exists, it does not seem to reflect itself in the analytical figures found for numerous undegraded nucleic acid samples of the same species; nor do the purine figures for whole sperm reported above indicate that any fractionation had taken place in the course of the isolation of the nucleic acid.

This work, which is being continued and extended to other species, was supported by a research grant from the United States Public Health Service.

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THE SUCCINIC OXIDASE SYSTEM AND ITS RELATION TO PHOSPHATE AND BICARBONATE

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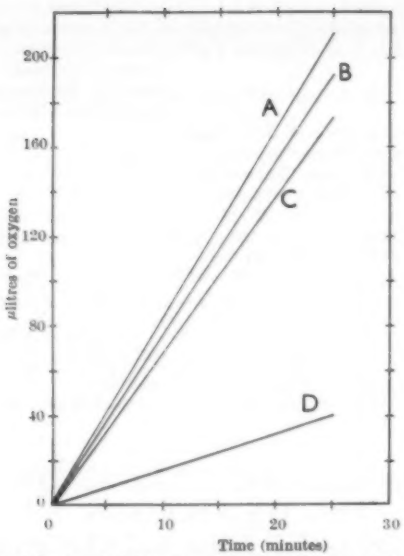
BALL AND COOPER[1] have recently presented a series of interesting experiments from which they have deduced the existence of a labile phosphorylated component in the succinic oxidase system which is essential for its activity. The mildly alkaline phosphate solutions which are generally used to extract the succinic oxidase system were avoided in this work, the catalytically active protein being extracted with potassium chloride. The final preparation was very active when tested under standard conditions in the presence of phosphate, succinate, and cytochrome *c*, but possessed little or no activity when bicarbonate or glycerophosphate buffers were substituted for phosphate. This preparation was rather fragile and lost a considerable portion of its activity daily, the loss being greatly accelerated in the presence of bicarbonate.

The hypothesis that a labile phosphorylated substance could be an essential component of the succinic oxidase system was made very doubtful by Keilin and Hartree[2] in their experiments with horse-heart muscle preparations which had been made in the usual manner but in which phosphate was substituted by glyoxaline buffer. Their preparations were not only active in phosphate, but also equally so in glyoxaline. As the glyoxaline preparation cannot be compared directly with that of Ball and Cooper, it was thought of interest to carry out further experiments on the latter preparation, which differs so markedly from those which are more generally used for investigations of succinate oxidation. For this purpose the succinic oxidase system prepared according to Ball and Cooper has been compared with an aqueous suspension of the Keilin and Hartree preparation.

The main part of this work was carried out with a heart muscle preparation which was made according to the method of Keilin and Hartree[3] and as described by Slater[4]. In order to obtain a preparation that was low in phosphate, the material from the acid precipitation was washed once with ice-water, collected by



Effect of denatured globin on an aqueous suspension of horse-heart muscle preparation in phosphate and in bicarbonate. Measurements made in 0·13 *M* phosphate (*p*H 7·3) or 0·025 *M* sodium bicarbonate — 5 per cent carbon dioxide — 95 per cent oxygen, 0·2 ml. of 1·4 per cent cytochrome *c*, 0·2 ml. of 0·4 *M* sodium succinate, and 0·3 ml. of 1·4 per cent denatured globin. Total volume in each vessel was 3·3 ml.

A, Phosphate + denatured globin; *B*, bicarbonate + denatured globin; *C*, phosphate; *D*, bicarbonate

centrifuging at 2,600 r.p.m. and suspended in an equal volume of water. One such preparation, containing only 0·004 mgm. inorganic phosphorus per mgm. dry weight, showed properties which corresponded almost exactly to those of Ball and Cooper's preparation, as will be seen below.

The succinic oxidase system of Ball and Cooper was prepared from fresh, twice-ground ox-heart muscle by following exactly the directions of these workers.

All measurements of activities were carried out in Barcroft differential manometers at 37°. Succinic oxidase activities were determined in 0·13 *M* phosphate (*p*H = 7·3) or 0·025 *M* sodium bicarbonate–5 per cent carbon dioxide. Q_{O_2} values are based on the fat-free dry weight.

Like the preparation of Ball and Cooper, the aqueous suspension of the horse-heart muscle preparation has very little activity when measurements are carried out in bicarbonate buffer, whereas it has high activity in phosphate. Thus, in one experiment, a Q_{O_2} of 413 was obtained in phosphate, whereas there was a negligible oxygen consumption in bicarbonate. This preparation, in contrast to that of Ball and Cooper, was rather stable in bicarbonate; after 60 min. incubation at 37° in bicarbonate, a loss of only 20 per cent of the original activity was found when tested in phosphate.

That the inactivity of the horse-heart muscle preparation in bicarbonate most probably arises from a change in the colloidal structure of the suspension is readily shown, not only by the recovery of activity in phosphate, but also by the complete reactivation in bicarbonate on the addition of an unspecific substance such as denatured globin which is insoluble at the *p*H of the experiment and forms a flocculent precipitate in the manometer flask. The effect of denatured globin is shown very clearly in the graph, where it may be seen that a small amount (0·3 ml. of a 1·4 per cent solution) causes complete reactivation of the system. Thus it can be seen that the low activity of this preparation in bicarbonate is, most likely, not due to the lack of an essential component in the system, but to an alteration of the colloidal properties of the suspension. Such a phenomenon has been shown repeatedly by Keilin and Hartree[2,5] for a variety of preparations, and in each case they have shown that unspecific substances which form flocculent precipitates upon which the tissue preparation can be adsorbed are capable of bringing about a complete change in the activity of the system in question.

It was thought probable that the preparation of Ball and Cooper could similarly be reactivated in bicarbonate by the addition of denatured globin. A preparation with an equivalent activity to that reported by these workers has not been obtained here, even after numerous trials and by following exactly their directions. The preparations that have been obtained possess a Q_{O_2} of 200–300 when tested in phosphate. In order to minimize the loss of activity, the final precipitate obtained in their step c was taken up in an equal volume of water and suitably diluted prior to use. On testing this material, both in phosphate and in bicarbonate, it was found that the Q_{O_2} obtained was dependent on the amount of preparation used (which was probably due to its high salt content), and, in contrast to the horse-heart muscle preparation where the activity in bicarbonate was independent of the concentration of the preparation, was very active both in phosphate and bicarbonate; low activities were obtained in bicarbonate only when very dilute suspensions were used. In suitably dilute suspensions, where the activity was very low in bicarbonate, this preparation could be completely reactivated by denatured globin, as is shown in the accompanying table, and from this type of experiment one can conclude that the effect of bicarbonate on Ball and Cooper's preparation is also on the colloidal structure of the particles in the suspension.

Effect of denatured globin on the succinic oxidase system of Ball and Cooper in the presence of phosphate (0·13 *M*) and bicarbonate (0·025 *M* — 5 per cent carbon dioxide). Each vessel contained, in addition to the buffer shown, 0·2 ml. of 1·4 per cent cytochrome *c*, 0·2 ml. of the heart muscle preparation, and 0·2 ml. of 0·4 *M* sodium succinate. 0·3 ml. of a 1·4 per cent denatured globin solution was used. Total volume in each vessel was 3·3 ml.

Buffer	Oxygen uptake (µl.O_2/hr.)
Phosphate	82
Phosphate + denatured globin	100
Bicarbonate	19
Bicarbonate + denatured globin	126

These experiments have provided further evidence for the importance of the colloidal structure of the succinic oxidase preparations. The interesting fact that preparations which are low in phosphate possess little activity in bicarbonate has been confirmed, and an alternative explanation to that of Ball and Cooper has been put forward.

I wish to thank Prof. D. Keilin and Dr. E. F. Hartree for their interest and advice in this work.

This work was carried out while holding a fellowship in cancer research of the American Cancer Society, recommended by the Committee on Growth of the National Research Council.

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FOOD HYGIENE

PROBLEMS of hygiene in the preparation, distribution and serving of food were the subject of discussion at a joint meeting of the Society for Applied Bacteriology and the Microbiological Panel of the Food Group of the Society of Chemical Industry, which was held in London in January last. Papers were read by Dr. W. A. Lethem, principal medical officer of the Ministry of Food, Dr. Betty C. Hobbs, of the Central Public Health Laboratory, London, and by Mr. D. H. F. Clayson, of Messrs. Lyons and Co., Ltd. These papers will be published in full in the *Proceedings of the Society for Applied Bacteriology*.

Dr. Lethem gave a short introduction to the symposium by dealing with the legislative aspects of the problems. He pointed out that the Ministry of Food acts largely in an advisory capacity and is mainly concerned with the drafting of regulations and model by-laws covering the hygienic handling and sale of food. The enforcement of legislation has always been, and still is, a matter for each particular local authority. In addition to helping local authorities in every way possible, the Ministry aims by wide propaganda at arousing public opinion so that a demand for hygienic measures in food matters should come from the consumer. On the question as to whether existing powers are sufficient to enforce an improvement in present-day standards, it is felt that in general the powers are adequate, although there is room for more in certain directions, such as in the control of open-air stalls and barrows. There is a striking difference between the extent and effectiveness of enforcement by different local authorities throughout Great Britain; but, in general, improvements are being made. The general standard of food hygiene in Great Britain is low enough to be a shock to visitors from some overseas countries.

Dealing with laboratory control of food hygiene, Dr. Hobbs outlined the chain of infection from human and animal reservoirs through handling and storage of the food to its consumption. Effective control would arise from breaking this chain at one or more links. Figures were given showing a definite increase in the number of outbreaks of food-borne infection over the past few years, and it was explained that this is attributable to an increase in communal feeding on one hand, and improved facilities for laboratory diagnosis of the etiology of the infections on the other.

With the exception of the *Salmonella* group causing the 'infection' type of food poisoning, many of which naturally infect domestic animals and vermin, and some of the anaerobic spore-bearing bacilli, man is the main reservoir of bacteria causing gastro-enteritis. *Salmonella*, including typhoid and paratyphoid bacilli, and dysentery bacilli may be transferred to food from human excreta via the hands of food handlers who are acute or convalescent cases or are symptomless chronic carriers.

The persistence of the chronic carrier state in the case of the enteric group of organisms is to be measured by years, and, although true carrier states following other *Salmonella* infections and bacillary dysentery are less common, there is evidence available to show that persistence can be considerable. Bacteriophage typing has proved invaluable in the laboratory for tracing cases and carriers associated with outbreaks of typhoid and some *Salmonella* infections.

Rat and mouse droppings may contaminate food with *Salmonella*, and certain rat poisons containing living *Salmonella* are potentially dangerous in food premises. Duck eggs are prone to infection from the oviduct with *S. typhi-murium*, and hen eggs may be contaminated externally with food-poisoning organisms from fæces in the nest. Lightly cooked egg dishes from whole or reconstituted dried egg may thus be responsible for food poisoning. Flies are potential carriers of contamination, both on their feet and in their fæces; but in Great Britain at the present time this vector may be considered to be of fairly low significance.

The 'toxin' type of food poisoning is most commonly caused by the development in the stored food of enterotoxins of certain pathogenic staphylococci. Fifty to sixty per cent of normal healthy people carry pathogenic staphylococci in the nose, and fifteen to twenty per cent are persistent hand-carriers of these organisms. Not all these staphylococci are able to produce enterotoxin in food. One or two serological and bacteriophage groups seem to be responsible, and laboratory diagnosis of the reservoir of infection is based on these methods of typing. The organisms are transferred from the hands to cooked foods during handling, and intoxication occurs when such foods are eaten cold at a later stage. The toxin resists boiling for twenty to thirty minutes, and, apart from human volunteers, no method is available to detect the toxin in food which has been heated enough to destroy the organisms but not the toxin.

Among the kinds of food most often involved in outbreaks of gastro-enteritis, by far the most common are made-up meat dishes, such as pies, pressed beef, brawns, hams and sausages; made-up fish dishes, puddings and other sweets, fresh and tinned milk, fresh and dried eggs, soups, stews, gravies and the like are also commonly involved. Following contamination of the food, there is usually necessary an incubation period for the multiplication of the bacteria or the development of the toxin. Here, time, temperature and moisture content of the food are the significant factors. Development of the food to an infectious stage is largely prevented by a short time of storage at a low temperature.

In addition to *Salmonella* and staphylococci described above, within the past year or two, three or more groups of organisms have been proved by human volunteer experiments to be the cause of gastro-enteritis. α-Hæmolytic streptococci, paracolon bacilli and certain types of *Clostridium welchii* have been incriminated in a few outbreaks. These strains of *Clostridium welchii* seem to differ from the known types, particularly in their resistance to heat. The source of the organism is not yet known.

Mr. Clayson pointed out that there is no essential difference between the laboratory and practical aspects of food hygiene. In order to prevent food-borne infections, one must know how they are caused and how the causative organisms can be eliminated. Little purpose is served by the routine examination of processed foods for pathogens; but it is important to ensure by bacteriological tests for index organisms, by plate counts and by appropriate physical tests that the process used is adequate to eliminate pathogens. From time to time, unsuspected organisms turn out to be pathogenic, and a theoretically sound process affords protection in all cases.

Bacteriological tests should not form the whole basis of an inspection programme. Visible dirt must be eliminated, since there may be opportunities for

the transfer of such dirt to food in the vicinity, for example, by draughts, insects, or contact with hands or clothing. A sense of hygiene must be inculcated into those concerned with food preparation and service, and lectures and demonstrations play an important part in their education. This must be supplemented by a comprehensive system of inspection and correction of faults if and when they occur. The principles of hygiene are not always easy to work out in practice, and frequent discussions with managerial staff regarding improvements of method are invaluable.

The hygienic precautions required in the preparation of food vary with perishability. In some instances handling is best avoided, whereas foods with comparatively dry external surfaces are not liable to become unsafe if handled. Perishability is related to the physical and chemical characteristics of the environment surrounding the contaminating organisms, but owing to the heterogeneous nature of most foods there is often a range of conditions in any one article. If preparation processes involve more than one stage, any bacterial contamination during early manipulation must be destroyed in the final stages, or prevented from increasing by refrigeration or other means if a final bactericidal treatment is impracticable.

In the service of food, much attention has been given to the cleaning and sterilizing of crockery and cutlery. It is also important to avoid deterioration of food through faulty estimation of requirements. Such deterioration can be avoided by preparing food in small units, by minimizing manipulation during service, by using food in correct order and by intelligent use of refrigeration. T. RICHARDS

BERNARD DYER AND AGRICULTURAL CHEMISTRY

SIR JOHN RUSSELL, in delivering the first Bernard Dyer Memorial Lecture of the Society of Public Analysts and Other Analytical Chemists*, paid a tribute to Dyer's high analytical attainments, intellectual honesty, human sympathy and the ready helpfulness that he invariably showed to younger colleagues. Sir John continued by giving many interesting but little-known biographical details of Dyer's early life and experiences in founding and consolidating an important analytical and consulting practice in agricultural chemistry.

When but twenty-one years of age, in 1877, he had set up in practice at 17 Great Tower Street, London, where he remained until the building was destroyed by a German bomb in May 1941. Here, he rapidly built up a reputation as an agricultural chemist of ability.

His work on the determination of available phosphorus and potassium by means of preliminary extraction with a 1 per cent solution of citric acid was among the earliest of his analytical achievements. This work formed the subject of a thesis on which the University of London in 1892 awarded him the degree of D.Sc.; later, in 1894, it was published by the Chemical Society. Lawes and Gilbert, realizing the nature of this work, invited Dyer to make a full examination of the soils of the famous Broadbalk wheat field at Rothamsted. This he did, and the results obtained by the citric acid method accorded well with the field experiments. The paper on this work was presented to the Royal Society and published in the *Philosophical Transactions*.

But Dyer did not occupy himself entirely with laboratory work and investigation into analytical methods. He saw clearly that if chemistry was to be of real help to agriculture it could only be through the closest association between the laboratory and the farm. With this object he went among the farmers and with their help conducted experiments in the fields. In all his field experiments he invariably dealt with some definite question of practical importance put to him by the farmers themselves. His part was to devise simple straightforward experiments that gave the required answer and to write a report in language that the farmers could understand.

Meanwhile soil investigation was continuing and was extended in England when the Goldsmiths' Company, in 1906, endowed a research post at Rothamsted, and still more so when the Development Commission, from 1911 onwards, made grants for agricultural research, which finally led to the formation of the Agricultural Research Council. These extended investigations showed the great complexity of the phosphorus and potassium compounds in the soil.

Moreover, Sir John continued, the processes by which the plant roots take up their nutrients from the soil had been shown to be much more complex than was at first thought, and that what is 'available' to one plant may not be 'available' to another.

The present-day problem was to find analytical methods that would give some measure of the amount of nutrients that crops could, under normal conditions, obtain from the soil. Dyer's method came into wide but not universal use. Other solvents, in steadily increasing numbers, had been proposed, but no two gave the same results. Curves expressing the results could be fitted by no ordinary equation. This problem was taken up at Rothamsted by J. A. Prescott and Sir John himself, who found that when dilute acids acted on soils, two reactions proceeded simultaneously: the acid dissolved phosphate, but the soil slowly absorbed it from the solution. This back-action was eliminated by using a diffusion technique, which showed that tenth-normal citric, hydrochloric and nitric acids all extracted the same amount of phosphorus, whereas by the ordinary analytical method the citric acid extracted nearly twice as much as the hydrochloric acid and fifty per cent more than the nitric acid. The citric acid had done this because it had reduced the difference between the amount extracted by the acid and the amount re-absorbed by the soil. Only the direct action was wanted by the analyst; the second action upset his results. So long as he was dealing with similar soils he could assume that the reverse action was also somewhat similar and that his results would still be comparable, but when he was dealing with different soils the reverse action might be different and he might get different analytical results even though the same amounts of phosphorus had been extracted. It was concluded, therefore, that soil analysis could be helpful when used in conjunction with a soil survey showing the areas of comparable soils, but that standards applied to one soil could not necessarily be applied to another.

Modern developments in technique had profoundly changed the whole subject. Citric acid long

* The First Bernard Dyer Memorial Lecture, delivered by Sir John Russell at the Seventy-sixth Annual General Meeting of the Society of Public Analysts and Other Analytical Chemists, on March 17.

retained its popularity because it extracted easily weighable amounts of phosphoric oxide and of potassium. This advantage was lost when the modern turbimetric, colorimetric and spectrographic methods, with their ability to deal with amounts too small to be satisfactorily weighed, came into use.

These new methods, along with automatic balances and pipettes, had speeded up analytical determinations enormously and had vastly increased the number of analyses that could be undertaken; but it was easy to become so absorbed by the elegance of the methods and the beauty of the apparatus that one was apt to forget that the figures had little intrinsic value. Their use was for comparison with known or standard soils, so far as other conditions permitted comparison to be made. The greatest value of soil analysis was realized when it was done in conjunction with field experiments.

We had to-day obviously gone a long way from the ideas that formed the background of Dyer's early work. The nineteenth century was a time of great generalizations, majestic in their comprehensiveness, magnificent in their simplicity. In this century the accumulation of awkward facts had broken down the old generalizations. The modern idea was still more complex. We were at the stage of recognizing the complexities, but not yet of expressing them in terms of mathematical equations and degrees of statistical significance.

The methods were at present empirical, and that meant that the analyst had to have close contact with field experiments to satisfy himself that they were reliable. He had to have a mind sufficiently open to reject them when they ceased to be so, and sufficiently alert to devise others that would be better. That, however, was no new situation for a consulting chemist. His work lay largely in regions not yet tidied up by the science of the day; his equipment had always to be a wide knowledge of scientific methods combined with ingenuity of invention, soundness of judgment and complete intellectual integrity. It was because Bernard Dyer possessed these qualities in so marked a degree that we honoured his memory, and in the words of Ecclesiasticus, counted him among those "that have left a name behind them that their praises might be reported".

SUPPLY AND DEMAND FOR PHYSICISTS

THE pamphlet "Present and Future Supply and Demand for Persons with Professional Qualifications in Physics"* is one of the series of five reports to which reference has been made in *Nature* (January 28, p. 125). A subcommittee, under the chairmanship of Lord Hankey and composed mainly of physicists, was appointed in September 1947 by the Technical Personnel Committee of the Ministry of Labour and National Service to examine the position regarding the probable demands for physicists in relation to the estimated supply over the next few years. The subcommittee included representatives of industry, the universities, technical colleges, government departments, and the Technical and Scientific Register of the Ministry of Labour and National Service. The report was finally approved in October 1948.

For the purposes of the inquiry a physicist was defined as a person qualified by means of a university degree in physics or in general science with physics as a main subject, and the fields of employment surveyed by the subcommittee were confined to those purely in physics, although some consideration was given to those on the border-line of engineering and technology. A very careful analysis of the requirements of industry, the research associations, government departments, the universities, and the teaching profession, for the periods 1948–50, 1951–55 and 1956 onwards, is given in the pamphlet, and on page 16 there is a summary in tabular form which shows clearly the estimated annual demands for physicists in the various organisations. The period 1948–50 is now almost past history, and it must be obvious that the large figure of 350 required annually for the teaching profession out of a total estimated demand of 865 and a supply of approximately 700 has been by no means met. The large number of attractive posts in industry and government research must have been filled at the expense of the teaching profession. From 1951 onwards, except for the teaching profession, it is estimated that the demand for physicists will steadily decline from a total of approximately 750 to about 600; for government departments it should drop from 175 a year in 1948–50 to fifty in later years.

In its general conclusions the subcommittee states (p. 20), "it is clear that after 1952 there is a possibility of over-supply of physicists"; but this is followed by the qualifications that it is not easy to forecast the future and that a purely quantitative assessment of the position may prove misleading. This conclusion of the subcommittee may quite easily be misinterpreted. Indeed, the *Times Educational Supplement* of December 16, 1949, commenting on the report, stated that physicists face "a bleak future", but in a subsequent letter (March 3) Lord Hankey has made it clear that there is no ground for taking such a gloomy view of the future of physicists. After 1952 there is a possibility of over-supply, not in the highest levels of research graduates, in which there will always be a shortage, but among the less able men. Even the latter may take some comfort from the fact that the subcommittee warns employers and government departments to have less regard for high academic qualifications and to consider also the importance of personal qualities and abilities. Further, the rapid expansion in the number of fields of application of physics means that an unpredictable number of so-called 'engineering physicists' may be absorbed in industry.

It is difficult to see, however, how the requirements of the teaching profession will ever be met, and particularly how the present deficiency in the number of physics teachers will ever be overcome. With the absence of sufficient good teachers of physics, the number of students wanting to read physics at the universities is bound to fall and the requirements in Great Britain of scientific man-power will not be met. The annual output of physics graduates from the universities is now about 750. This represents a considerable increase above the pre-war number and even above that of the Barlow report; and, while every effort should be made to maintain the quality, it would appear, from the report, undesirable at present to limit or discourage the number of entrants to the university physics schools.

* Ministry of Labour and National Service: Technical and Scientific Register. Present and Future Supply and Demand for Persons with Professional Qualifications in Physics. Pp. 32. (London: H.M. Stationery Office, 1949.) 6d. net.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Longitudinal Migration of Phosphorus in a Sensory Nerve after Stimulation

THE difference between the longitudinal distribution of radioactive phosphorus in the sural nerve of rabbits at rest and in activity has been described in a previous communication[1]. It has now been shown that there is a similar redistribution of the total phosphorus in isolated nerves.

After cutting the nerve, the distribution of phosphorus first undergoes a series of changes, apparently because of stimulation by the injury discharges[2]. The sural nerves of rabbits anæsthetized with urethane 30 min. previously were ligated at the upper part of the thigh and middle of the leg and cut close to the ligature. The total phosphorus in the three sections, proximal, middle and distal, was estimated by the method of Berenblum and Chain[3]. The total phosphorus of resting nerve is between 300 and 400 μgm. per 100 mgm. wet weight, and if the three pieces of nerve were assayed immediately after it had been cut, the phosphorus content was approximately equal in all three pieces, the mean difference between the phosphorus content of the proximal and distal pieces being only 6 ± 4 μgm. per 100 mgm. (twenty-eight nerves). But a very different distribution was found if the nerves were either left in position in the rabbit's leg with the muscles and skin sutured over, or removed to a warm, moist chamber with a constant supply of carbon dioxide[4]. When the nerves were left for 10–50 min. after cutting the ends, the proximal phosphorus content was always higher than the distal, the differences amounting to 115 ± 10 μgm. per 100 mgm. (eleven nerves). The difference was greatest between 30 and 40 min. after cutting. However, in nerves left for 50–120 min. before assay, the distribution of the phosphorus between the three pieces was similar to that after immediate estimation as described above, amounting only to 10 ± 8 μgm. per 100 mgm. (eleven nerves). Everything points to the above sequence of events being due to excitation by injury discharges.

If the shift is due to activity, one would expect that electrical stimulation, after the nerve had gone through the above sequence, would again cause redistribution throughout the length of the nerve. Eleven sural nerves of rabbits anæsthetized with urethane were ligated and cut, and left for 50–110 min. These nerves were then stimulated electrically at their distal ends in the moist chamber for 20 min. The nerves were laid on wicks moistened with saline, in contact with silver/silver chloride electrodes, and the action potential was recorded throughout the period of stimulation by two similar electrodes supporting the other end of the nerve. The rate of stimulation was 30–60 per min. and the stimulus was maximal. The resulting difference between the phosphorus content of the proximal and distal pieces was marked, the content of the proximal piece being greater than the distal in all cases, and the difference amounting in the mean to 134 ± 19 μgm. per 100 mgm. (eleven nerves).

When the proximal end (that is, the end which was nearer the cord when the nerve was in the rabbit) was stimulated instead of the distal end, under the same conditions as just described, the phosphorus content of the *proximal* section again became greater than that of the distal section. The difference between proximal and distal was, in the mean, 123 ± 20 μgm. per 100 mgm. (ten nerves).

These results show that the distribution of phosphorus in the sural nerve of rabbits is radically changed by stimulation *in vitro*, and that the direction of the change is set, not by the direction of the propagation of the impulse, but by some inherent organisation of the fine structure of the nerve.

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Cytological Demonstration of Alkaline Phosphatase

Jacoby and Martin[1] have recently pointed out that diffusion of phosphatase may occur during the process of incubation which forms part of the technique of Gomori and Takamatsu for the cytological demonstration of alkaline phosphatase. I can confirm that artefacts may arise in this way. But there is no difficulty in deciding to what extent the results obtained by this method are valid, provided the technique is supplemented by some additional techniques published in 1946[2].

The manner in which the Gomori technique should be used is as follows: to ascertain the regions of highest phosphatase activity, sections should be incubated for a logarithmic series of times, the actual times being chosen according to the concentration of phosphatase in the tissue—for example, 5, 10, 20, 40, etc., minutes for normal rat kidney. The sites of highest activity appear positive for phosphatase before other sites, and no supplementary techniques are necessary for the correct localization of these sites. Sites of lower activity become evident after more protracted incubation times. Since these longer incubation times introduce the possibility of artefacts due to diffusion, supplementary techniques, such as those published in 1946, are necessary.

Most of the published work on the cytochemistry of phosphatase does not appear to have been controlled in this way, and is therefore open to question. Judging from this and other published work in cytochemistry, it appears that the technique of Gomori, like many other cytochemical techniques, suffers from a deceptive simplicity. It appears to be essential to have a good working knowledge of physics and chemistry for the proper use of these methods, even in a qualitative manner.

It should also be emphasized that while a number of other cytochemical techniques have been proposed for the demonstration of enzymes, such as acid phosphatase, phosphamidase, lipase, etc., no critical studies of these methods are yet available. Con-

sequently, the value of the results obtained by these methods cannot yet be assessed.

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Penetration of the Spermatozoon *in vitro* into the Mammalian Ovum Oxydo Potential Level

A GREAT many attempts have been made to obtain *in vitro* fertilization of the eggs of mammals. The appearance of ovum segmentation has been interpreted as proving the penetration of spermatozoon into the oocyte (Schenk (1880), Onanoff (1873), Pincus and Enzmann (1930–39), Krassovskaja (1934), Menkin and Rock (1948)). *In vitro* production of parthenogenetic segmentation in the oocyte of mammals, mentioned by Champy in 1927, is a well-known fact; therefore segmentation is no criterion of fertilization. Moricard and De Fonbrune (1937), Lewis and Hartmann (1941) stated that they had not been able to obtain *in vitro* penetration of the spermatozoon into oocyte. So recently as December 1947, Dr. G. W. Corner, director of the Embryology Department in the Carnegie Foundation, said in a letter: "I am sorry to say that no one in this laboratory has observed the penetration of the spermatozoon into the mammalian ovum. To the best of my knowledge no such observation has ever been made in mammals."

In January 1949 in the *Bulletin de l'Association des Gynécologues de langue française*, Moricard and Bossu commented: "tubal secretion has a rather low rH_2; a remark which is probably important as regards the attempts for *in vitro* fertilization". This hypothesis has proved very fruitful.

(1) *Under aerobic conditions in vitro*, in a medium in which methylene blue remained oxidized ($rH_2 >$ 14 at *p*H 7), contact was established between sixty secondary oocytes and spermatozoa. In no case has a spermatozoon penetrated into the zona pellucida. Many of them stopped on the external edge of this membrane.

(2) *Under relatively anaerobic condition in vitro*, in a medium in which methylene blue is reduced ($rH_2 < 14$ at *p*H 7), the oocytes were enclosed in pieces of tube placed under 'Vaseline' oil in the presence of spermatozoa. Twenty-one oocytes were cultivated in this way. In fourteen oocytes there was penetration by spermatozoa into the zona pellucida, and a total of forty-seven spermatozoa penetrated it. In only five oocytes did penetration of one fertilizing spermatozoon into the oocyte cytoplasm occur. For all oocytes the metaphase of second maturation mitosis has a variable position; in four cases it became central, which is not normal. The second polar body was not formed and ovum segmentation was not observed during the whole of our culture (7½ hr.). This negative result is perhaps related to the carbon dioxide tension in the pieces of tube.

Summing up, under relatively anaerobic conditions, we have obtained *in vitro* penetration of spermatozoa through the zona pellucida of rabbit oocyte, and penetration of one single fertilization spermatozoon into the oocyte cytoplasm.

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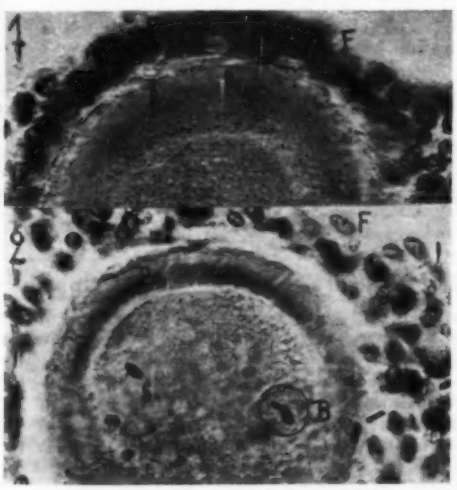

In vitro penetration of the spermatozoon into the rabbit oocyte. (1) Penetration of one spermatozoon (*S*) into the zona pellucida (*P*). Follicle cells (*F*) undissociated.

(2) Penetration of one spermatozoon (*S*) into the oocyte cytoplasm. First polar body (*B*) visible. Some spermatozoa in the follicle cells.

Serial sections 20 μ thick. Feulgen reaction; only the nuclei and the head of the spermatozoa are stained red. Cytoplasm and zona pellucida are stained green

Ethnology of Sicklæmia in Uganda

THE contribution of Lehmann and Raper[1] on the distribution of sicklæmia in the Africans of Uganda is of prime importance in the ethnology of the continent.

The relationship between the various tribes can best be estimated on a basis of the underlying genes rather than on the distribution of the manifestations —sickle-cell trait. The sickle-cell trait is transmitted as a Mendelian dominant, and therefore the frequency of the recessive normal gene can be calculated from the square root of the frequency of normal individuals; the remainder corresponds to the frequency of the dominant gene in the population thus:

Phenotype	Genotype	Frequency
Sickle trait (pure)	SS	S^2
Sickle trait (hybrid)	Ss	$2Ss$
Normal	ss	s^2

and for the genes:

$$s = \sqrt{ss} = \sqrt{\text{normals}}$$
$$S = 1-s.$$

For the main groups of tribes in question this gives:

Table 1. SICKLE CELL GENES IN UGANDA

Group	No.	Sicklæmia	Gene S	Gene s
Hamites	574	0·0261	0·0131	0·9869
Nilotes	993	0·2568	0·1379	0·8621
Banyaruanda group	707	0·0934	0·0478	0·9522
Baganda group	950	0·1894	0·0997	0·9003
Basoga	448	0·2946	0·1601	0·8399
Teso	416	0·1779	0·0933	0·9067
Baamba	140	0·4500	0·2583	0·7416

The races can be grouped along a line according to the frequency of the sickle cell gene in them[2], and their relative positions on this line, as shown in Fig. 1, will thus indicate the relative proportions of the various types of ancestry.

This line has the property that the effect of mixture is observed quantitatively. For example, if we regard the Baganda at 0·10 as 'pure' Bantu and the primitive position of the Hamite as zero, then the present-day Hamite is approximately 13 per cent Bantu and the Teso is 93 per cent Bantu. This is merely illustrative of the method and these figures have no real value.

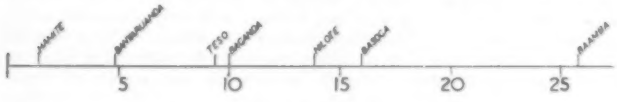

Fig. 1

The blood group genes for some of these peoples[3] are as shown in Table 2.

Table 2. BLOOD GROUP GENES IN UGANDA

	Gene $A = p$	Gene $B = q$	Gene $R = r$
Bahima	11·3	7·1	81·3
Teso	13·4	13·0	72·2
Lango	16·3	17·1	64·1
Baganda	10·2	6·6	82·9

As the blood groups are due to triple allelomorphic genes, these peoples may be placed on a two-dimensional chart[4] (as against the single dimension for the pair of genes for sicklæmia). Fig. 2 shows this representation where the ordinate is the frequency of gene A $(= p)$ and the abscissa gives the frequency of gene B $(= q)$.

It appears that the sickle-trait factor must be in a different dimension from that of the blood groups,

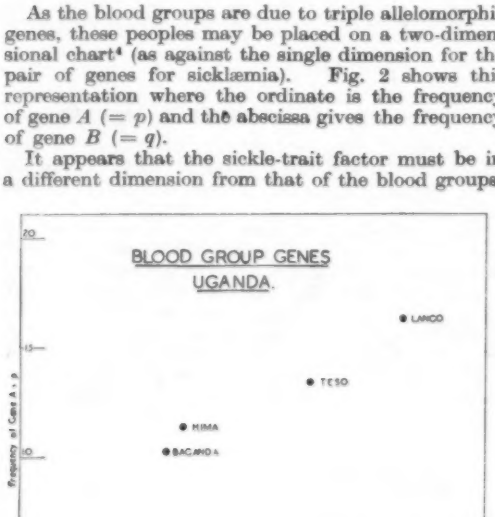

Fig. 2

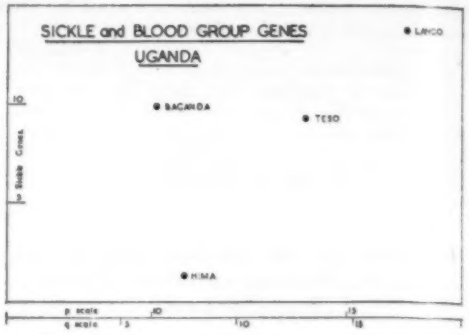

Fig. 3

and if we assume one line representing p and q on different scales as the abscissa, and show the frequency of the sickle-cell gene on the ordinate, we get Fig. 3, which illustrates the relative position of the Teso with reference to the Hamitic, Nilotic and Bantu peoples.

Care is necessary in the interpretation of the figures for sicklæmia, as such a gene is probably partially lethal. In fact, it has been suggested that the double-dominant gene determines the onset of sickle-cell anæmia[5]. Lehmann and Raper do not state whether care has been taken to avoid families in the collection of their records, for where a hereditary factor is involved the inclusion of families may load the figures considerably. In my discussion I have not mentioned the Baamba, for they may constitute an 'isolate'.

The genetic approach to ethnology is probably the only absolute method, and it was with great appreciation that I saw the letter by Lehmann and Raper.

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The Coombs Test and Guinea-Pig Complement

THE Coombs test[1,2] makes use of an anti- (human-serum-protein) to agglutinate washed sensitized red cells.

Bordet[3], investigating the claims of various workers who reported that they had made specific anti-antibodies (*anti-sensibilisatrices*), concluded that these substances were not specific for each antibody but had merely the broad specificity of anti- (serum-protein). In the same paper he noted that when an anti-sensitizer reacted with a sensitizer-red-cell complex it removed from it the property of being afterwards hæmolysed by complement.

Ehrlich[4] noted this observation of Bordet upon (as he, Ehrlich, called them) anti-amboceptors, and said that their activity was directed solely against the complementophilic receptor, and that this explained

Mixtures	Rabbit serum + sensitized cells	Rabbit serum + fresh guinea-pig complement in excess	Rabbit serum + fresh guinea-pig complement (heated to 56° C. for 30 min.) in excess	Sensitized cells + fresh guinea-pig complement in excess	Sensitized cells + fresh guinea-pig complement (heated to 56° C. for 30 min.) in excess
		Leave for half an hour at 37° C.			
		+ sensitized cells	+ sensitized cells	+ rabbit serum	+ rabbit serum
Coombs test	Strong pos.	Strong pos.	Strong pos.	Strong pos.	Strong pos.

why they were independent of the cytophilic specificity of the sensitizing antibody.

In the experiment summarized in the table, fresh active guinea-pig complement was added to rabbit anti-human serum and to human red cells sensitized with strong incomplete anti-*D* serum. In neither case was there any blocking or weakening of 'Coombs' receptors, as judged by the subsequent tests. The experiment has not been performed with other types of complement.

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Hæmagglutinins from *Mycobacterium tuberculosis*

IT is known that erythrocytes from some fowls are agglutinated by certain lipid preparations and by components of vaccinia and ectromelia viruses. The vaccinia hæmagglutination is inhibited by sera of rabbits infected with the virus, but not significantly by those of normal rabbits. In contrast, agglutination by common lipid preparations, such as those used by Stone[1], is inhibited by normal rabbit sera to a relatively high titre.

The results reported here show that tubercle bacilli of avian, bovine and human strains elaborate substances capable of agglutinating fowl red cells susceptible to the lipid type of agglutination.

Living and heat-killed tubercle bacilli which had been grown on a synthetic fluid medium were extracted for several hours with three aliquots of petroleum ether (b.p. 30–60° C.), and then washed with acetone and dried. Next they were stirred in ten to twenty times their weight of 88–90 per cent phenol at 30–37° C. for twenty-four hours. The mixture was then centrifuged at 2,000 r.p.m. for 20 min. to remove most of the bacilli from the phenol solution. The supernatant fluid was placed in a 'Cellophane' bag and dialysed against running tap water for forty-eight hours. Water-insoluble material which appeared during dialysis was removed by centrifugation at 3,000 r.p.m. for 30 min. in an angle centrifuge. The supernatant was colourless and very slightly opalescent.

This aqueous preparation was found to have a high content of agglutinins for fowl cells susceptible to lipid agglutination. For example, one preparation of 250 c.c. made from 6 gm. dry weight of petrol-ether-extracted organisms (human strain) had a hæmagglutinin titre of 1/80,000 at room temperature. Fowl red cells insusceptible to lipid agglutination were not thus agglutinated by this preparation. A limited number of sera from normal and tuberculous (avian and bovine) rabbits have been titrated for activity in inhibiting this agglutination. All sera of infected rabbits, when tested against an extract prepared from the bacterial strain used for infection, inhibited hæmagglutination to a considerably higher titre than did normal sera (for example, normal rabbit serum 1/20, infected rabbit serum 1/640).

The petrol-ether extract contained water-insoluble material. Suspensions of this in saline also agglutinated these cells; but in this case the agglutination was inhibited to the same degree by the sera of normal and infected animals.

The phenomena reported in the present note should not be confused with those described by Middlebrook and Dubos[2]. These authors observed that, although erythrocytes treated with a saline extract of phenol-extracted tubercle bacilli failed to agglutinate spontaneously, these cells became specifically agglutinable by sera of animals and human beings infected with tubercle bacilli.

These observations were made at the Institute of Animal Pathology, University of Cambridge, and have since been confirmed in the laboratories of the Rockefeller Institute for Medical Research, New York City, where the work is continuing, during my tenure of a Wellcome Fellowship of the Animal Health Trust.

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Biosynthesis of Vitamin C in Germinating Legumes

WORKING on sprouted mung (*Phaseolus radiatus*), we have observed that, contrary to what has been reported for the maturing fruit[1], there is a rapid and progressive decrease in the proportion of ascorbic acid to dehydro-ascorbic acid with germination, which is paralleled by corresponding increases in ascorbic acid oxidase activity. Germination in absence of light or after short preliminary periods of steeping in the cold (5° C.), which result in 62 and 23 per cent respectively enhanced vitamin C formation during five days, also cause lowering of oxidase activity; these treatments are additive in their effects. Typical of related changes are the increases in glutathione, reducing sugars and amylase activity, phosphates and phosphatase activity, and nicotinic acid. Especially interesting are the increases, in five-day old seedlings germinated in the dark, in glutathione (158 per cent) and total ascorbic acid (45 per cent) on one hand, and the decreases in dehydro-ascorbic acid (37 per cent) and oxidase activity (25 per cent) on the other. The changes in the reductase activities were not followed; but the results of germination in the dark cannot be explained on the basis of the effect of glutathione on dehydro-ascorbic acid alone[2], on account of the difference in the total

ascorbic acid contents of these seedlings as compared to those sprouted normally.

Irradiation hastens the oxidative destruction of ascorbic acid[3]. Hence, in seeds germinated in dark, there is a check on both enzymic and non-enzymic oxidations. The increase in reducing sugars (29 per cent in five days) would also be expected to stimulate vitamin formation, since sugars and sugar acids are definitely concerned in its biogenesis[4–6]. In growing plants, sugars, being products of photosynthesis, will be formed in proportion to the photo-energy received[7], whereas, during germination, these result from amylolysis of stored carbohydrates. The influence of chlorophyll on ascorbic acid formation[8] is therefore indirect and applicable only to the growing plant.

Results obtained on the distribution of the reduced and oxidized forms of vitamin C and of its enzyme systems between the leaves, cotyledons and stems have shown that the changes are most pronounced in the leaves, which also possess a powerful mechanism protecting the vitamin against enzymic oxidation. The unknown precursor to ascorbic acid in the cotyledons and stems is evidently supplied to the leaves, they themselves lacking the capacity to bring about this transformation.

The effects of pre-treatment by steeping in the cold on the dehydro- and ascorbic acids of germinating mung are similar to those on germination in darkness. As, however, there has been no apparent modifications in environmental conditions such as would affect possible photo-oxidative changes that have been assumed in explaining the results of germination in the dark, a different mechanism must have been responsible for this effect.

The observations reported here on mung could generally be confirmed with *Cicer arietinum*, *Pisum arvense*, *Lens esculenta* and *Phaseolus aconitifolius*. Further work is in progress.

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Effect of the Dietary Fat on the Composition of the Depot Fats of Animals

The fats of animals have been shown to originate in part by synthesis from dietary carbohydrate[1] and protein[2], and in addition the dietary fat is generally considered to exert a marked effect on their composition. In connexion with the effect of dietary fat on the composition of the depot fat, Smedley-MacLean[3] states: "Beef suet, mutton fat and lard each has a definite character of its own, but this can be modified if exceptional quantities of any particular acid are included in the diet. If, for instance, a large amount of linseed oil is supplied, a greater proportion of the liquid unsaturated acids characteristic of linseed will be stored and the fat will become softer."

Work recently carried out in this Laboratory[4] does not accord completely with the generally accepted view indicated by Smedley-MacLean. Comparison of the fats of pasture-fed animals, where the main dietary fatty constituent is linolenic acid, shows that whereas horse fat contains up to 17 per cent of this constituent and, in addition, bears some resemblance to a mixture of 'synthetic' fat and dietary fat, beef and mutton tallow contain little, if any, linolenic acid, and have a fatty acid composition suggesting the almost complete absence of any unmodified pasture fat. Earlier work by Thomas, Culbertson and Beard[5] showed that feeding liberal allowances of highly unsaturated oils to steer calves over a period of 260 days was without perceptible effect on the mean unsaturation of the body fat. It therefore appears that, contrary to current conceptions, certain animal fats, such as beef and mutton tallow, are not appreciably modified by the nature of the dietary fat.

From consideration of these facts it is now possible to divide animal fats into two types:

(*a*) Fats, the fatty acid composition of which is substantially unaffected by the nature of the dietary fat, as in beef and mutton tallow. It is proposed to designate such fats by the term 'heterolipoid', to indicate lack of resemblance to the dietary fat. (I am indebted to Dr. Muriel E. Bell, Nutrition Research Department, Otago Medical School, Dunedin, N.Z., for suggesting appropriate terms.)

(*b*) Fats which readily incorporate the fatty acids present in the dietary fat. For such fats it is proposed to use the term 'homolipoid' to designate similarity in composition to that of the ingested fat.

Most animal fats apparently belong to that latter type; but some, such as cow milk fat, are intermediate in type, in that while their composition is not very readily altered by the nature of the dietary fat, nevertheless, by feeding certain oils such as rapeseed oil[6], it is possible to incorporate small proportions of fatty acids (in this instance erucic acid) which are not normally found in such fats.

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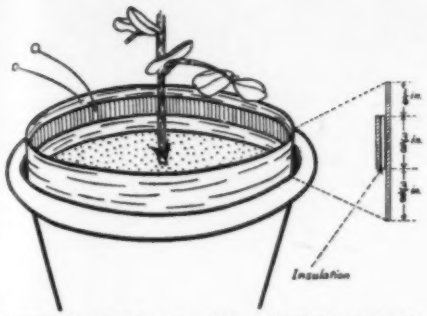
An Insect Barrier Utilizing High-Frequency Current

During a series of toxicological studies with insecticides, it became desirable to use a method of restricting certain apterous insects to the proximity of their host plants without creating the microclimatic conditions associated with cages. The apparatus detailed below was designed to confine apterous forms of pea aphids (*Acyrthosiphum pisi* Kalt) to pea plants in pots so that both plant and insect were fully exposed to the controlled environment of the laboratory. The system developed has also proved efficient when used against other non-flying insects, namely, *Aphis fabæ* L., certain Noctuid



The insect barrier, (left), in position on the plant pot; (right), in vertical section showing the concentric metal contact surfaces separated by insulation

larvæ and Capsid nymphs, and it would appear to have a much wider sphere of application.

Electrical insect barriers utilizing direct currents have been in use for some years; but we are unaware of any report of an alternating current being used for this purpose. Insects receiving a 'shock' from a D.C. system often show a damaging, rigid, muscular paralysis, and in certain cases individuals may be killed by a current which is normally just sufficient to prevent escape. The barriers are usually arranged in parallel to each other so that the entire system is short-circuited should an individual succumb and fall across the contact surfaces. The high-tension battery (a usual source of current) is then rapidly discharged.

However, with high-frequency alternating currents, no apparent injurious symptoms have been noted for any of the species of insects against which it has been tried in this laboratory. Indeed, the effect is, if anything, stimulating, and the insects are not loth to leave the points of contact, thus obviating the risk of short-circuit.

A specially constructed, simple valve-oscillating unit is worked from a 'mains' source of electricity (200–240 volts at 50 cycles/sec.) and gives an output of 35 volts at 1,000 cycles/sec., a potential found to be an effective barrier. A voltmeter, placed in parallel with the barriers, indicates a zero reading should a short-circuit occur, while switches placed at intervals break up the circuit into sectors each of about eight barriers, and thus facilitate the location of 'shorts'.

The illustration shows the construction of the metal barriers, which are attached in parallel to the circuit by leads about 9 in. in length so that they can be quickly put in position on, and removed from, the plant pots. Their diameter is such that they fit just within the rim of the plant pot, the top of which is covered with a thin layer of sand. Thus insects which are disturbed by treatment and fall off the plant are afforded an opportunity of regaining the host.

If the barriers are made from an easily oxidized metal (for example, tin) a film of oxide eventually forms, and this is sufficiently insulating to allow the insects to escape. It can be cleaned off periodically with a metal polish.

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Possible Identity of Three Citrus Diseases

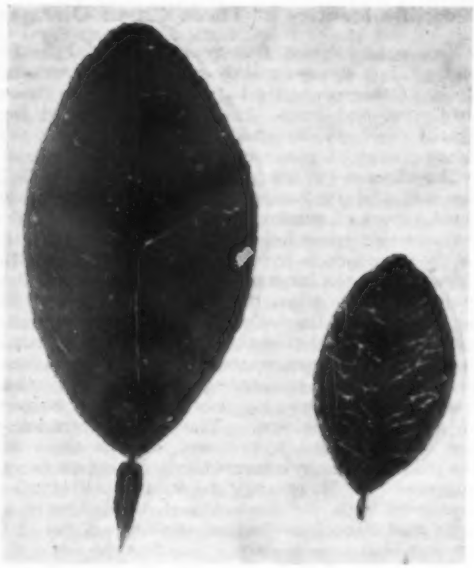
Xyloporosis[1] was first reported from Palestine, where it is a disease mainly of citrus on sweet-lime stock. Other countries to record the same disease are Cyprus and Syria. In 1938 came a report from Brazil[2] of a similar condition in association with Barao orange on root stocks of Lima da Persia.

The disease, which was described in detail by Reichert and Perlberger[1], takes its name from the development of numerous small pits in the wood of the sensitive sweet-lime. Corresponding in position to the depressions in the wood are small peg-like elevations on the inner surface of the bark, and these fit into the pits when the bark is in position. The development of the lesions is apparently associated with failure of the cambium to function normally in the affected zones, where an irregular mass, somewhat triangular in shape, of thin-walled tissue eventually develops in place of normal elements of xylem and phloem. The mass protrudes on one side into the xylem and on the other into the phloem. The cells surrounding the lesions become impregnated with gum and degenerate. Other effects associated with the disease, such as decline of the scion and loss of mechanical strength of the stock, are regarded as secondary.

The cause of xyloporosis was not satisfactorily explained. Reichert and Perlberger, though they did not exclude the possibility of virus infection, preferred the theory that the disease is caused by some unknown physiological factor or complex of factors. Moreira[2], of Brazil, on the other hand, attributed the condition to incompatibility between stock and scion; but, as Reichert and Perlberger[3] point out, did not explain why xyloporosis sometimes appeared on unbudded trees of sweet lime.

Stem pitting, primarily a disease of grapefruit in South Africa and neighbouring territories, was first described by Oberholzer *et al.*[4], who also reported transmission by budding, though actually they did no more than show a perpetuation of the disease in budlings developed from diseased parents. When bark is removed from the stems of affected trees, pits, or more usually shallow grooves of varying lengths, will be found in the underlying wood, in which they tend to follow a somewhat twisted course in the direction of the grain. These lesions are not always evident on young branches, but are well defined in the wood of the larger limbs and trunk of the tree. On the inner surface of the bark are found elevated areas that fit into the depressions in the wood. The anatomical changes associated with the lesions are similar to those described for xyloporosis. Most of the outward effects of the disease, such as depressions in the trunk and larger branches, a general decline in vigour and growth, and decrease in the yield and size of the fruit are secondary and become increasingly evident as trees become older. Other forms of citrus in South Africa to show symptoms of wood-pitting are Bailedge Early orange, West Indian lime, citron, shaddock and sweet-lime (when used as a stock).

It has now been established that a virus is associated with diseased grapefruit and is capable of transmission to healthy grapefruit seedlings to produce the symptoms of wood-pitting. Transmission has been obtained by budding, by tissue grafts, and by using *Aphis citricidus* Kirk. as a vector. In addition to grapefruit, the virus has been recovered from Bailedge Early orange, Sampson tangelo, Natal



Veinal fleckings on leaves of West Indian lime, produced by stem-pitting virus

tight skin naartjie and also from normal-looking trees of Valencia orange and Lisbon lemon. The aphis vector is abundant in citrus orchards, and at present the evidence suggests that the virus is widespread, perhaps almost universal, in commercial citrus orchards in South Africa, though it does no apparent damage to the main varieties of sweet oranges, which are grown on rough lemon stock.

Recently, Hughes and Lister[5] described from West Africa a disease of seedling lime trees, the cause of which is a virus existing in at least two strains. The symptoms include a die-back, veinal fleckings of the young leaves and severe pitting of the trunks and branches. It was also noted that most sweet citrus and rough lemon are apparently symptomless carriers of the virus.

The West Indian lime has proved an excellent indicator plant in our studies on the disease in grape-fruit. On seedlings of this species the first symptom appears on the young leaves, often within one or two months of inoculation, in the form of whitish, translucent flecks in the veins. Other symptoms that may follow are a general yellowing of the topmost leaves, which often assume a more upright position and become cupped, the development of corky eruptions along the veins on the upper surface of some leaves, the development of pits in the wood of the stem, and retarded growth. These symptoms are apparently those of the lime disease described by Hughes and Lister. It was, indeed, as a result of conversations with Mr. Lister during a visit to South Africa that we began using West Indian limes in the first instance, and from photographs of our lime seedlings infected from grape-fruit, Mr. Lister has been able to confirm that the two diseases appear identical. From the behaviour of these test plants we have evidence also of the existence of two strains of virus.

It is the purpose of this note to direct attention to the close similarity of the three citrus diseases mentioned above. The primary symptom of wood-pitting is common to the three. As further evidence, sweet-limes have been consistently disappointing as a stock in South Africa because of the dwarfing of the scion, and all sweet lime stocks which we have had an opportunity of seeing have shown wood-pitting seemingly identical with xyloporosis in Palestine. From two dwarfed scions, a Valencia orange and a Lisbon lemon, an infection has been obtained apparently identical with the virus of stem-pitted grape-fruit.

If, as seems likely, xyloporosis is the same as stem-pitting, which is almost certainly the same as the disease of limes, the causal virus of the three diseases should be called the *Citrus* xyloporosis virus.

A full report of the work mentioned in this communication will be published later.

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Dec. 21.

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Chromatographic Observations on Nitrogenous Constituents of Petroleum-Ether Extracts of Plasma

During an investigation of the amino-acids of human blood plasma by paper partition chromatography, it was found that a considerable fraction of the amino-acids were soluble in fat solvents such as ether or petroleum-ether. These solvents were used to remove lipides from the deproteinized plasma, as suggested by de Verdier and Ågren[1].

The plasma protein was precipitated with absolute alcohol (final concentration 70–80 per cent), the filtrate was 'desalted' by the method of Consden, Gordon and Martin[2], and then dried *in vacuo* for a prolonged period to ensure removal of the last traces of water and alcohol. The dried filtrate was then extracted with several volumes of cold, anhydrous, petroleum ether (boiling range 40–60° C.) to remove lipides. However, chromatography (with phenol and collidine) of the petroleum-ether extract, concentrated fifty times compared with the original plasma volume, showed the same pattern of amino-acids as was present in the petroleum-ether-insoluble fraction of the plasma, except that glutamine was in much higher concentration in the petroleum-ether-soluble fraction. As judged from the chromatogram, roughly 20 per cent of the plasma amino-acids were soluble in the petroleum ether, and about 80 per cent of the plasma glutamine. Acid hydrolysis of the petroleum-ether extract (6*N* hydrochloric acid, 105° C., 24 hr.) caused the glutamine to disappear, and caused a considerable increase in the aspartic and glutamic acids, glycine, valine and leucine, indicating the presence of combined forms of amino-acids in the petroleum ether extract. Folch and Van Slyke[3] and Christensen[4] noted that non-lipide substances, including amino-acids, were present in petroleum-ether extracts of blood plasma (prepared by Bloor's method); but the more precise identification of the individual amino-acids, afforded by chromatography, has not previously been described. It is clear that the use of fat solvents, in preparing plasma for chromatographic analysis, may seriously alter the

amino-acid picture, and in particular, most of the plasma glutamine may be removed.

The presence of non-lipide material in petroleum-ether extracts has been ascribed to a 'solubilizing' effect of phospholipides on these substances[3], and dialysis has been suggested as a method of freeing the lipides from these 'incidental contaminants'[4–6]. In order to see whether all the 'extra nitrogen' was, in fact, dialysable, the following experiment was performed. The petroleum-ether extract, emulsified with water, was dialysed for three days in a 'Cellophane' tube against eight changes of distilled water at 4° C. Dialysis removed the amino-acids, glutamine, and some conjugated amino-acids; but a unidimensional chromatogram with phenol of the dialysed extract (concentrated about five hundred times compared with the original plasma volume) showed a ninhydrin-reacting spot extending from approximately R_F 0·7 to the edge of the phenol front. This spot disappeared on acid hydrolysis and the following amino-acids appeared: aspartic ++, glutamic ++++, serine +, glycine ++, valine +++ and leucine +++. This indicated the presence of non-dialysable combined amino-acids, possibly a peptide, in the petroleum-ether extract.

When unidimensional chromatograms of the dialysed petroleum-ether extract were run with phenol, material giving a blue fluorescence under ultra-violet light was found corresponding to the position of the ninhydrin-reacting material. This fluorescent area gave a positive test for fat with Sudan III, and osmic acid, and for choline[7]. The presence of ninhydrin-reacting and lipide material in the same position on the chromatogram suggests the possibility of the non-dialysable peptide being in actual combination with a plasma lipide, and that it is not merely an 'incidental contaminant' of the petroleum-ether extract of the plasma.

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Dec. 20.

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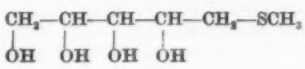
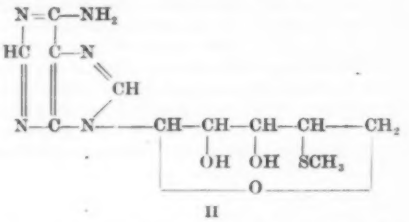
Structure of Adenylthiomethylpentose

According to Nakahara *et al.*[1], adenylthiomethylpentose has the same effect as vitamin L_2 (L_1 is said to be anthranilic acid). Adenylthiomethylpentose was isolated from yeast[2], from crude oryzanine[3], and from impure cozymase[4], and yielded adenine and thiosugar on acid hydrolysis. Falconer and Gulland[5] state that the thiosugar is combined to the 9-position of the adenine. The thiosugar itself has been the subject of several studies: according to Suzuki, Ohdake and Mori[3,6], the thiosugar gives the Molisch test with all other reducing sugar tests, and strong pentose reactions, but gives neither the methylpentose reaction nor Seliwanoff's. The sulphur can be detected only after fusion of the thiosugar with metallic sodium; and by estimation of the thiomethyl group, the Japanese authors assigned to the sugar the structure of 5-thiomethylpentose, and showed that the sugar could be reduced by means of sodium amalgam to the thiomethyl group containing polyalcohol (thiopentitol) (I).



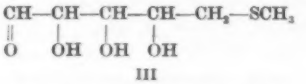
I

Levene and Sobotka[7], and Suzuki *et al.*[3], found that the sulphur was retained during osazone formation, therefore excluding positions 1 and 2 of the sugar as the combining position for sulphur. A paper by Wendt[8] based on titration by the Willstätter–Schudel method showed that the thiosugar was an aldose, and it was then demonstrated that on decomposition with lead tetra-acetate, thiopentitol (I) yielded 0·9 mol. of formaldehyde, indicating that the 3-position cannot be the combining position for the thiomethyl group. But this result proves only that a thiomethyl group cannot be in the 3-position, and offers no definite explanation for deciding whether thiomethyl groups are attached at the 4- or the 5-position; that is, other structural formulæ, especially (II), cannot be excluded.

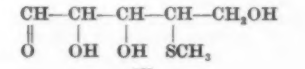


II

Hence the structure of adenylthiomethylpentose has not been definitely established. We have therefore carried out some experiments with this compound. When the adenylthiomethylpentose was submitted to periodate oxidation, two oxygen atoms were used, one by the thiomethyl group, for methionine used also one oxygen atom with periodate, while the amino-acid portion was left intact. But in the mother liquor of the adenylthiomethylpentose oxidation no formic acid was detected. It was found that the thiosugar solution obtained by heating the pentose with diluted sulphuric acid (normal solution) for 1·5 hr. in a sealed tube required 1·9 mol. of iodine in a Willstätter–Schudel titration, indicating that both an aldehyde and a thiogroup are almost simultaneously oxidized, for thiopentitol (I), which has no aldehyde group, also consumed 0·9 mol. of iodine to form the sulphoxide. A newly prepared thiosugar solution took up four atoms of oxygen with periodate, indicating that the thiosugar has the structure (III), for (IV) must require three oxygen atoms in all.



III



IV

Furthermore, thiopentitol (I) consumed exactly four atoms of oxygen with periodate, yielding 0·9 mol. of formaldehyde (detected as formaldimedone after distillation of the mother liquor), and 2 mol. of formic acid titratable with alkali. These results indicate

that the natural thiopentose must have the thiomethyl group in position 5, excluding the possibility of other positions. What, then, is the structure of this thiopentose?

Raymond[9] has synthesized 5-thiomethylxylose, and proved that the osazone of this compound (this must be 5-thiomethylxylosazone or 5-thiomethyl-lyxosazone) differed from that of the natural compound. So two remaining pentoses, namely, 5-thiomethylribose and 5-thiomethylarabinose, must be taken into consideration. To settle this question we applied the Boeseken boric acid reaction to adenylthiomethylpentose. The Boeseken test was applied by Makino[10] and Lohmann[11] to establish the chemical structure of adenosinetriphosphoric acid. This structure has been confirmed by Lythgoe and Todd[12]. Adenosine, muscle adenylic acid and adenosinetriphosphoric acid give a positive reaction, while for nucleotides from yeast nucleic acid the reaction is negative.

Glucose, which gives a positive reaction, becomes negative when combined into saccharose, indicating that the *cis*-hydroxyls of glucose are lost by the formation of a δ-oxide ring. In the case of adenylthiomethylpentose, the Boeseken test was as strongly positive as that of adenosine. The two hydroxyls at positions 2 and 3 of the thiosugar are therefore not only uncombined but also arranged to the *cis*-position, indicating that the thiosugar is a derivative of ribose. Comparing these results with those obtained from periodate oxidation of adenylthiomethylpentose, we assign to the latter substance the accompanying structure (V) (9′-(5-thiomethyl-ribofuranosyl)-adenosine).

V

Furthermore, we have found that adenylthiomethylpentose can reduce methylene blue in a Thunberg tube in the presence of ox liver extract, and after preliminary incubation showed the same decolorizing time as that of adenosine. These facts suggest strongly that the thiosugar belongs to the D-ribose system.

We are indebted to Dr. S. Ohdake for a gift of adenylthiomethylpentose and to Prof. T. Mori for a gift of thiopentitol.

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Molecular Composition of Dextran Solutions for Intravenous Use

SOLUTIONS of degraded dextran have been shown to be a promising plasma substitute in a number of clinical trials. The practical problem in designing this substitute is to select dextran of the correct molecular size from the wide range of sizes in a partial hydrolysate. To obtain the maximal effect for the minimal quantity of dextran, the smallest dextran molecules which are retained in the blood vessels should be used.

In the course of a recent investigation[1], it was observed that the dextran recovered from the urine of patients transfused with dextran had a lower intrinsic viscosity, and hence a lower average molecular weight, than that of the dextran which had been given intravenously. One case received a transfusion of 4·54 l. of 6 per cent dextran in 0·9 per cent saline, the solution having an intrinsic viscosity of 0·29. Within forty-eight hours 23 per cent of the dextran was excreted. The dextran so recovered had an intrinsic viscosity of 0·11. Thus it appeared that 23 per cent of this particular dextran preparation was of little value, since it was rapidly excreted by the kidneys. Similar results were obtained in other cases.

Experiments on fractional precipitation revealed that the gradual addition of 50 ml. of acetone to 100 ml. of the solution used for transfusion precipitated 78 per cent of the dextran, this fraction having an intrinsic viscosity of 0·35. The 22 per cent remaining in the supernatant solution had an intrinsic viscosity of 0·15. This showed that it would be possible to reduce the content of low molecular-weight dextran by acetone fractionation and thus obtain an improved plasma substitute. An alternative approach would be to modify the degradation of the crude dextran, which is achieved by acid hydrolysis.

Experiments were made to demonstrate the effect of varying the proportion of small molecules on urinary excretion of dextran. Dextran in urine and saline solutions was determined by hydrolysing in 2*N* sulphuric acid at 100° C. for four hours and determining the glucose produced by the method of Schaffer and Hartman. Urine from rabbits which had not received dextran was found to contain a small but widely varying quantity of hydrolysable carbohydrate; the average amount in a 24-hr. sample being 108 mgm., with a standard deviation of 96 mgm., based on the analysis of fifty-nine samples. Accordingly, 108 ± 96 mgm. has been subtracted from the dextran determination on each urine sample. Rabbits weighing 2·5–3·5 kgm. were injected with about 20 ml./kgm. of 6 per cent dextran in 0·9 per cent saline, and 24-hr. urine samples immediately preceding and for three days after the injection were analysed for dextran.

The percentage of the dose appearing in the urine after the injection of different preparations of dextran is shown in the accompanying table. Preparation *A*, having an intrinsic viscosity of 0·29, is the one referred to above. Preparations *B* and *C* were prepared from *A* by fractional precipitation as described. The intrinsic viscosity, reflecting the average molecular size, has increased owing to removal of low-molecular dextran. Correspondingly less of the dose was excreted. Preparation *D* was obtained from *A* by carrying out the fractional precipitation twice. Injection of preparation *D* was followed by negligible

excretion during the first twenty-four hours; but in the second 24-hr. period some 8 per cent of the dose given was excreted. The significance of this delay in excretion is not yet clear.

A slightly different technique of fractionation was applied to preparation *E*, yielding preparations *F* and *G*.

Preparations *I* and *H* were prepared from a crude dextran solution by acid hydrolysis, the process continuing longer in the case of fraction *I* than in that of fraction *H*. Neither was fractionated with acetone. A correspondingly higher proportion of *I* appeared in the urine after intravenous injection.

Preparation	Intrinsic viscosity	Dose (gm.)	Percentage of dose appearing in each 24-hr. urine sample		
			0–24 hr.	24–48 hr.	48–72 hr.
A	0·29	4·4	11·7	—	—
A	0·29	3·02	15·4	—	—
B	0·35	3·29	6·2	—	—
C	0·37	2·53	6·1	—	—
D	0·46	3·25	0·6	8·1	1·9
E	0·21	3·16	47·5	—	—
F	0·23	4·94	35·2	8·1	0·0
G	0·29	4·10	21·7	0·26	0·0
H	0·36	4·37	0·8	1·4	0
I	0·28	4·12	12·8	2·7	0

Variation of basal excretion would account for a standard error of between 1·9 and 3·7 on the above percentages.

It thus appears that the effectiveness of dextran as a plasma substitute, as judged by the excretion of this substance in the urine in the first 24–48 hr., can be improved by: (1) the application of fractionation procedures aimed at removing low molecular-weight dextran; or (2) by variation of the degradation process. Of these the former is preferable, because it can be adjusted to yield a smaller range of molecular size.

Although in this account the effect of the proportion of small molecules on the urinary excretion of dextran and the ways in which this proportion may be varied have been briefly considered, the presence of large molecules tends to reduce the osmotic effect of these solutions and may also have other undesirable effects. Further experiments are being undertaken in which the persistence of relatively homogeneous dextran fractions in the tissues of experimental animals and their effects upon the histological structure of the tissues will be examined.

We wish to thank Prof. J. R. Squire and Dr. J. P. Bull for advice and criticism, and to acknowledge the assistance of Mr. A. R. Lockwood, of Dextran, Ltd., in providing 'Dextran'.

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Emulsion Reactions: the Hydrolysis of Wool Wax

It has long been known that wool wax is hydrolysed only with great difficulty as an oil-in-water emulsion. For example, only about 40 per cent reaction is obtained after boiling with $N/2$ sodium hydroxide for 100 hr. We find that in a water-in-oil emulsion, hydrolysis proceeds very much more rapidly, and is complete in 6 hr. at 100° C. when 1 gm. of wax is treated with 1 ml. of 6 N sodium hydroxide. The difference between the two results is not due solely to the greater concentration of alkali as reactant, but is determined mainly by changes in the nature of the interface and the effect of reaction products upon it. These effects have been isolated in the following experiments.

When 2N sodium hydroxide is used at 60° C., the water/oil emulsion is unstable and the reaction-rate is low (28 per cent reaction in 10 hr.). On adding 5 per cent of sodium palmitate to the wax before treatment with alkali, a stable emulsion is obtained and the rate of reaction increased (37 per cent in 10 hr.). With 6N sodium hydroxide at 60° C. a stable emulsion is obtained, and the effect of added soap on the reaction-rate is small (64 per cent increased to 67 per cent for a 10-hr. reaction time). As would be expected, therefore, one factor which influences the rate of reaction between wool wax and sodium hydroxide is the magnitude of the interface.

Emulsion stability is not, however, the only factor involved. The other reaction products, namely, cholesterol and various other alcohols, are also capable of giving stable water/oil emulsions; but the addition of cholesterol to wool wax prior to reaction with sodium hydroxide reduces the rate of reaction. For example, with 6N sodium hydroxide at 80° C., the extent of reaction was 93 per cent, compared with 75 per cent for wax to which 5 per cent cholesterol had been added, for the 10-hr. period. In this case, the presence of a condensed film due to cholesterol at the interface[1] delays the reaction by making it difficult for the ester to come into contact with the alkali. The difficulty can be overcome by adding a small amount of ethanol to the aqueous phase. For example, with 6N sodium hydroxide at 60° C., the extent of reaction in 10 hr. is 64 per cent, compared with 84 per cent when the aqueous phase contains 10 per cent by volume of ethanol.

In practice, the hydrolysis of wool wax need not be carried out with highly concentrated aqueous sodium hydroxide solutions, because it has been found that a 2N solution of sodium hydroxide in 4N sodium chloride solution at 60° C. is just as effective as 4N sodium hydroxide solution at the same temperature. This illustrates the dual function of the alkali as an electrolyte and as a reactant[2].

A full account of this work will be published elsewhere. We are indebted to the International Wool Secretariat for financial assistance.

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Beryllium and Alkaline Phosphatase

RECENTLY, two papers[1,2] have appeared in which it has been shown that beryllium inhibits alkaline phosphatase by competition with magnesium. However, as inhibitions of more than 60 per cent were rarely attained, the results are of qualitative interest only. The authors were presumably aware of the insolubility of beryllium phosphate, since their alkaline phosphatase preparations were dialysed "to remove all traces of inorganic phosphate"[2]. But the inhibitor, beryllium, was added to the substrates (B. glycerophosphate or disodium phenyl phosphate) before the enzyme. These substrates undoubtedly contain inorganic phosphate in concentrations comparable to those of the inhibitor.

Alkaline phosphatase has been prepared from rabbit kidney by a slight modification of the method of Abul-Fadl *et al.*[3] and dialysed until the concentration of inorganic phosphorus was 2 μgm./ml. ($6{\cdot}6 \times 10^{-5}$ *M*). This enzyme solution (90 Armstrong–King units/mgm. protein nitrogen) was diluted 125 times for use, giving a final phosphorus concentration of $5{\cdot}3 \times 10^{-7}$ *M*. The enzyme in carbonate/bicarbonate buffer was incubated with beryllium sulphate, the substrate added and the activity determined by the method of King[4]. Table 1 shows the inhibition of the unactivated and magnesium-activated enzyme.

Table 1

Unactivated enzyme		Activated enzyme, $1{\cdot}0 \times 10^{-3}$ *M* magnesium	
Concentration of beryllium during incubation with enzyme (*M*)	Inhibition (per cent)	Concentration of beryllium during incubation with enzyme (*M*)	Inhibition (per cent)
$5{\cdot}2 \times 10^{-6}$	100	$1{\cdot}7 \times 10^{-6}$	95
$1{\cdot}3 \times 10^{-6}$	79	$1{\cdot}7 \times 10^{-6}$	70
$3{\cdot}3 \times 10^{-7}$	66	$3{\cdot}3 \times 10^{-7}$	30
$8{\cdot}1 \times 10^{-8}$	43	$1{\cdot}7 \times 10^{-7}$	15
$2{\cdot}0 \times 10^{-8}$	24		

An experiment was also designed to find out whether the reversal of inhibition by magnesium was immediate. In Table 2 the results of such an experiment are given. The enzyme was incubated for 10 min. with either beryllium or magnesium, followed by magnesium or beryllium respectively, for various periods of time.

Table 2. Beryllium concentration $3{\cdot}3 \times 10^{-7}$ *M*. Magnesium concentration $1{\cdot}3 \times 10^{-3}$ *M*. All percentage inhibition values based on activity of fully activated enzyme

No.	Addition for first 10-min. incubation	Further addition	Inhibition (per cent)	
1	Beryllium	Nil	80	
2		Magnesium for 2 min.	30	Mean 30
3		" " 10 "	26	
4		" " 30 "	34	
5	Magnesium	Nil	0	
6		Beryllium for 2 min.	35	Mean 36·5
7		" " 10 "	37	
8		" " 30 "	38	

This demonstrates that the reversal of beryllium inhibition is immediate. Grier[1] states that if the enzyme is incubated for long periods with beryllium, the inhibition becomes difficult to reverse. Preliminary experiments indicate that this is probably also an artefact, since the control inhibition experiments were carried out in the presence of substrate (containing inorganic phosphate). Further work is in progress and will be reported later.

Beryllium is thus an extremely potent inhibitor of alkaline phosphatase (50 per cent inhibition concentration for the unactivated enzyme is $1{\cdot}2 \times 10^{-7}$ *M*, and for the magnesium-activated enzyme, $6{\cdot}6 \times 10^{-7}$ *M*). Addition of magnesium (ratio of concentrations Mg : Be $\approx$ 40,000 : 1) reduces inhibition from 80 to 30 per cent. This reversal of inhibition is immediate. The hypothesis that beryllium may compete for the magnesium in magnesium-activated enzymes may help to provide an explanation of the toxic properties of beryllium.

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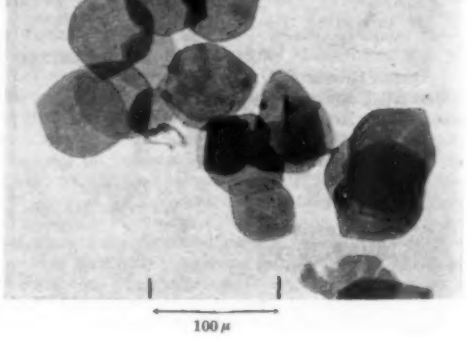
Crystallization of Congo Red

ACCORDING to Robinson and Mills[1], "in general, the cotton substantive dyes cannot be recrystallized from water". But some of the benzidine disazo dyes may with difficulty be recrystallized from alcohol-water mixtures[2].

It has been confirmed that the potassium salt of Congo Red will crystallize as needles from various ethyl alcohol–water mixtures, but only with difficulty and generally in company with much amorphous material. As a result of an accidental observation during a trial of various salting-out procedures, however, the potassium salt of Congo Red has been found to be precipitated in crystalline form by salting out with potassium acetate at about 95° C. in the following way.

A 2 per cent solution of Congo Red (B.D.H. indicator) in water is heated on a water bath to 95° C., and 20 per cent by volume of 40 per cent wt./vol. potassium acetate solution (adjusted to slightly pink to phenol phthalein) is added slowly with vigorous stirring. The crystalline precipitate which forms immediately is filtered off hot on a glass filter, redissolved in water to make a 2 per cent solution and the crystallization carried out four more times. The



100 μ

crystals are then washed thoroughly on a glass filter with boiling 98 per cent ethyl alcohol until free from potassium acetate, and dried in a vacuum desiccator over phosphorus pentoxide.

Microscopic examination shows that practically no amorphous material is present. As shown in the photomicrograph, the crystals are very thin optically anisotropic plates. In the polarizing microscope they exhibit remarkably beautiful red-blue optical dichroism.

When the five-times recrystallized material is precipitated in exactly the same way with potassium acetate at 0° C. as at 95° C., although a few crystals are formed, the bulk of the precipitate is amorphous.

The simplest explanation of the effect of temperature on the crystallization would seem to be that a large steric factor or entropy decrease is involved in the crystallization process, and that raising the temperature consequently favours the rate of formation of crystalline more than that of the amorphous material. If this explanation is correct, one would expect that many substances of high molecular weight would crystallize better at high temperatures than at the customary temperature of 0° C., particularly in salting-out procedures and in methods involving precipitation from aqueous solution by addition of organic solvents.

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Rutin in Two Eucalypts

MAIDEN[1] in 1887 and Smith[2] in 1897 noted the presence of rutin (identified by Perkins[3]) in the leaves of *Eucalyptus macrorrhyncha* (F. v. M.) or red stringy bark, which occurs abundantly through the hilly country of Victoria and New South Wales. The increasing importance of rutin in the treatment of capillary fragility has led to the possibility of using *E. macrorrhyncha*, or other eucalypts in which it might occur, as an economic source of rutin.

Samples were collected from natural stands in the Australian Capital Territory, New South Wales and Victoria. The material was examined by a method based on that of Sando and Bartlett[4], wherein the bulk of oils and pigments are first removed by ether, then the rutin is extracted with boiling ethyl alcohol, the alcohol removed by distillation, the rutin crystallized from water and recrystallized from water and alcohol as recommended by Couch *et al.*[5]. The results were calculated as the percentage of recrystallized rutin in the dried sample.

Rutin isolated in this way crystallizes in tiny pale yellow needles, sintering at 189–190° C. and melting at 214° C. Samples of rutin kindly assayed by Dr. Couch by a spectrophotometric method[6] yielded 98–99 per cent rutin after the removal of some alcohol-insoluble material. No quercetin was detected.

Samples assayed green, dried at room temperature, in a drier at 46° C. for six hours and in an oven at 90° C. for six hours, showed that the decomposition of rutin in the leaf during drying was insignificant. In this respect, *E. macrorrhyncha* differs markedly from buckwheat, wherein Couch, Naghski and Krewson[7] found considerable losses on slow drying at low temperatures.

By taking whole branches of mature trees and dividing the leaves into four samples based on their physiological age, it was found that the rutin content was highest in the young leaves (average 15 per cent, highest result 24 per cent) and decreased as the leaves matured to about 6 per cent in two-year-old leaves. Any differences in the rutin content due to season or geographical location were masked by this leaf-age relationship. Contrary to expectations, young regrowth from cut stumps contained only 2–5 per cent of rutin, and coppice growth had a lower rutin content than mature trees from the same area. The youngest twigs contained about 6 per cent rutin, but the content decreased rapidly as the stem matured. Rutin was isolated in small amounts (about 2 per cent) from young flower buds, but none could be obtained from bark or wood.

Rutin was isolated and identified by melting point, mixed melting point and examination of the products of hydrolysis in four samples of *E. Youmani* (Blakely and McKie) collected in the Guyra district of New South Wales. The yields (6·8–11·0 per cent) were comparable with those obtained from *E. macrorrhyncha*.

The following eucalypts were tested for the presence of rutin with negative results: *E. dives*, *E. capitellata* Sm. (brown stringy bark), *E. Muelleriana* Howitt (yellow stringy bark), *E. eugenioides* Sieb (white stringy bark), *E. obliqua* (Messmate) and *E. Tinghænsis*.

The work described in this paper was carried out as part of the research programme of the Division of Plant Industry, Commonwealth Scientific and Industrial Research Organisation.

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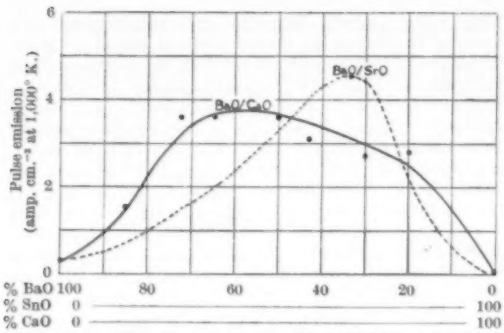
Thermionic Emission from the BaO–CaO System

DURING our work on the available thermionic emission from mixtures of the alkaline earth oxides (barium, strontium and calcium oxides), we have studied the properties of the system barium oxide – calcium oxide. The accompanying diagram shows that a variation of emission with composition is obtained, as in the case of the barium oxide – strontium oxide system[1], which we have remeasured at the same time.

These measurements have all been carried out using an indirectly heated cathode standard diode, and measuring the maximum space-charge limited pulsed (2-μsec., 50-cycle) emission. Each of the coating mixtures was tested in at least four tubes and the average readings used to plot a Richardson line, from which the graph recorded here was taken.

After a study of the thermionic properties of the oxides, the tubes were opened in an atmosphere of



Molecular percentages of barium oxide with either strontium oxide or calcium oxide

nitrogen and the cathodes dipped in molten wax[2]. X-ray examination at room temperature showed that no barium oxide – calcium oxide solid crystals were present.

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Preliminary Investigation of Gravity Anomalies

Because of similarity in methods of observation and reduction, it is possible to combine the gravity data of the United States Coast and Geodetic Survey and the Department of Mines and Resources of the Dominion of Canada in large-scale gravity investigations. The combined data include gravity observations extending from lat. 24° N. to 67° N. and from long. 52° W. to 133° W., an extent of 43° in latitude and 81° in longitude. This region includes large variations in topography and in geology, and has considerable coastal regions.

A variety of interests and careful planning have resulted in a distribution of gravity stations over most of this area. The gravity stations are non-uniformly distributed. However, they are located over an area which is sufficiently large to reduce the effect of local phenomena in the mean anomaly for the entire area. This mean anomaly may not give a true conception of the isostatic condition of the crust of the region; but the sign and the magnitude of the anomaly may indicate the adjustment which should be made to the international gravity formula,

$$\gamma_\phi = 978{\cdot}049\,(1 + 0{\cdot}0052884\sin^2\varphi - 0{\cdot}0000059\sin^2 2\varphi)\ \text{gals},$$

in order that it may apply more accurately. Table 1 gives the results of the mean anomaly determination.

Table 1. Mean Gravity Anomalies

Region	Stations: Total	With positive anomaly	With negative anomaly	With zero anomaly	Mean anomaly Depth 113·7 km. $(g - \gamma_\phi)$ without regard to sign	Mean anomaly. Depth 113·7 km. $(g - \gamma_\phi)$ with regard to sign
					gals	gals
U.S.	1122	410	692	20	0·021	−0·009
Canada	163	62	97	4	0·016	−0·005
U.S. and Canada	1285	472	789	24	0·020	−0·008

The fact that the mean gravity anomaly for Canada is a little greater than one half the mean anomaly for the United States raises the question as to the existence of the dependency of the gravity anomaly on latitude.

In order to reduce purely local effects to a minimum, latitude regions, five degrees in width, were established from lat. 20° N. to lat. 60° N. Groups were formed of stations closer than ten miles, and each group was considered as having an anomaly equal to the mean anomaly of the group. Because there were only four stations in the entire 20° N.–24° N. region, these stations were not included in Table 2.

Table 2. Latitude Variation of Gravity Anomalies

Latitude range	Number of stations and groups	Mean anomaly. Depth 113·7 km. $(g - \gamma_\phi)$ without regard to sign	Mean anomaly. Depth 113·7 km. $(g - \gamma_\phi)$ with regard to sign
25° N–29° N	75	0·015 gals	−0·012 gals
30° N–34° N	216	0·016	−0·008
35° N–39° N	188	0·015	−0·013
40° N–44° N	245	0·020	−0·003
45° N–49° N	151	0·018	−0·002
50° N–54° N	49	0·013	−0·001
55° N–59° N	13	0·010	−0·002

An inspection of Table 2 shows a rather definite division of the latitude-ranges into two parts on the basis of mean isostatic gravity anomalies with regard to sign as shown in Table 3.

Table 3. Grouping of Latitude Range Variations of Gravity Anomalies

Latitude range	Number of stations and groups	Mean anomaly. Depth 113·7 km. $(g - \gamma_\phi)$ without regard to sign	Mean anomaly. Depth 113·7 km. $(g - \gamma_\phi)$ with regard to sign
25° N–39° N	479	0·015 gals	−0·011 gals
40° N–59° N	458	0·018	−0·003

Table 3 shows that the mean anomaly for the lower latitudes, 25° N.–39° N., is almost four times larger than the mean gravity anomaly for the 40° N.–59° N. range. In the case of the mean gravity anomaly without regard to sign, the two latitude ranges have very similar values, with the lower-latitude group having the smaller mean value.

The mean gravity anomalies with regard to sign, as shown in the last column of Table 2, do not indicate that such a variation of anomalies is a function primarily of the geographical latitude, but that it is probably due to some other factor or factors having latitude distribution. Because of the small anomaly which is shown to exist in the region, the Dominion of Canada has been selected as a suitable region for a statistical study of deflexions of the vertical which have been isostatically reduced and the isostatic gravimetric anomalies. Results of this investigation will be published in the near future.

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FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, May 15

UNIVERSITY OF LONDON (at the London School of Economics and Political Science, Houghton Street, Aldwych, London, W.C.2), at 5 p.m.—Prof. R. O. Buchanan: "Approach to Economic Geography".*

CHEMICAL SOCIETY, OXFORD SECTION (in the Physical Chemistry Laboratory, Oxford), at 8.15 p.m.—Prof. E. L. Hirst, F.R.S.: "Some Problems in the Chemistry of Starch and Glycogen" (Alembic Club Lecture). (All Fellows are invited.)

Tuesday, May 16

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5 p.m.—Mr. I. G. Cunnison: "Some Types of History among the Luapula Peoples".

INSTITUTE OF SOCIOLOGY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. Kenneth Little: "Tensions—Racial Relations".

Tuesday, May 16—Friday, May 19

ILLUMINATING ENGINEERING SOCIETY (in the Playhouse Theatre, Buxton).—Summer Meeting.

Wednesday, May 17

At 10.15 a.m.—Dr. L. A. Sayce: "Visual Deception"; at 2.30 p.m.—Mr. R. O. Ackerley: "Floodlighting".

Thursday, May 18

At 10 a.m.—Mr. H. Hewitt: "Lighting of Fibre and Fabric"; at 2.30 p.m.—Annual General Meeting; at 3 p.m.—Mr. Ivar Folcker: "Lighting in Sweden, 1940–50".

Friday, May 19

At 10 a.m.—Mr. L. G. Applebee: "Stage Lighting in the Post-War Theatre in Great Britain"; Mr. J. M. Waldram: "Street Lighting".

Wednesday, May 17

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Mr. Peter Lamont: "Rural Water Supplies".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Dr. Paul Woldstedt: "The Pleistocene Succession in North Germany"; Prof. S. E. Hollingworth, Mr. J. Allison and Mr. H. Godwin: "Interglacial Deposits from the Histon Road, Cambridge".

PHYSICAL SOCIETY (at the Royal Institution, Albemarle Street, London, W.1), at 5 p.m.—M. P. Jacquinot: "Quelques recherches sur les raies faibles dans les spectres optiques" (Fifth Holweck Discourse).

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, London, S.W.7), at 5 p.m.—Dr. J. S. Forrest: "Variations in Thunderstorm Severity in Great Britain"; Mr. Morris S. Bower: "The Thunderstorm Census Organisation". (Members of the Institution of Electrical Engineers are invited.)

UNIVERSITY OF LONDON (in the Physiology Theatre, University College, Gower Street, London, W.C.1), at 5.15 p.m.—Prof. F. Bremer (Brussels): "The Physiology of the Central Nervous System".* (Further Lectures on May 19 and 23.)

INSTITUTION OF ELECTRICAL ENGINEERS, SUPPLY SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. C. W. Marshall: "A Review of Research in Electricity Supply".

OIL AND COLOUR CHEMISTS' ASSOCIATION, LONDON SECTION (at Manson House, 26 Portland Place, London, W.1), at 7 p.m.—Mr. N. H. E. Ahlers: "Absorption Spectroscopy in Paint Research".

WOMEN'S ENGINEERING SOCIETY (at 35 Grosvenor Place, London, S.W.1), at 7 p.m.—Discussion on "Women and Radio".

SOCIETY FOR VISITING SCIENTISTS (at 5 Old Burlington Street, London, W.1), at 7.30 p.m.—Discussion on "The Use of Radioactive Isotopes in Industry and Research" (Speakers: Dr. W. J. Arrol, Mr. K. Fearnside and Dr. W. G. Marley).

Thursday, May 18

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2).—Commemoration of the Centenary of the Birth of Oliver Heaviside. At 3 p.m.—Sir George Lee: "Heaviside the Man"; at 5.30 p.m.—Prof. Willis Jackson: "An Appreciation of Heaviside's Contribution to Electromagnetic Theory"; Prof. B. van der Pol: "Heaviside's Operational Calculus"; Dr. W. G. Radley: "Fifty Years' Development in Telephone and Telegraph Transmission in relation to the Work of Heaviside"; Mr. H. J. Josephs: "Some Unpublished Notes of Heaviside".

INSTITUTION OF MINING AND METALLURGY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 4 p.m.—Annual General Meeting; at 5.15 p.m.—Colonel L. C. Hill: Presidential Address.

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Dr. F. Kidd, F.R.S.: "Food Research under the Department of Scientific and Industrial Research".

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. T. M. Cherry: "Theory of Iteration and Divergent 'Small Divisor' Series".

ROYAL SOCIETY OF ARTS, INDIA, PAKISTAN AND BURMA SECTION (at John Adam Street, Adelphi, London, W.C.2), at 5.15 p.m.—Dr. Christoph von Fürer-Haimendorf: "The Aboriginal Tribes of India—the Historic Background and their Position in Present-day India".

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Manson House, 26 Portland Place, London, W.1), at 7.30 p.m.—Prof. R. M. Gordon: "The Problem of Loiasis in West Africa".

BRITISH INSTITUTE OF RADIOLOGY (in the Reid-Knox Hall at 32 Welbeck Street, London, W.1), at 8.15 p.m.—Annual General Meeting; at 8.45 p.m.—Dr. L. H. Gray: Presidential Address.

Thursday, May 18—Sunday, May 21

BRITISH INSTITUTE OF MANAGEMENT (at Cliftonville, Margate).—Spring Management Conference.

Friday, May 19

BIOCHEMICAL SOCIETY (in the Physiology Institute, Newport Road, Cardiff), at 2 p.m.—Scientific Papers.

INSTITUTE OF NAVIGATION (at the Royal Geographical Society, 1 Kensington Gore, London, S.W.7), at 4 p.m.—Symposium on "Marine Radio Position Fixing Systems".

Saturday, May 20

BRITISH PSYCHOLOGICAL SOCIETY (in the Physiology Theatre, University College, Gower Street, London, W.C.1), at 2.30 p.m.—Prof. G. P. Meredith: "The Transmission of Knowledge".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

CHEMIST to work on insecticide problems in London—The Secretary, Agricultural Research Council, 6a Dean's Yard, London, S.W.1 (May 20).

RESEARCH ASSISTANT for investigations on histology—The Registrar, The University, Liverpool (May 20).

ASSISTANT LECTURER IN PHILOSOPHY—The Registrar, University College, Singleton Park, Swansea (May 22).

LECTURER (Grade II) IN GEOLOGY, and a LECTURER (Grade II) IN THE DEPARTMENT OF HORTICULTURAL SCIENCE—The Secretary and Registrar, The University, Bristol (May 27).

CHEMISTS on the scientific staff of the Chief Engineer's Department in the Research Laboratories at Leatherhead—The Director of Establishments, British Electricity Authority, British Electricity House, Great Portland Street, London, W.1, quoting AE/60 (May 29).

CEREAL BOTANIST (Punjab Agricultural Service, Class I), with headquarters at Lyallpur—The High Commissioner for Pakistan, 35 Lowndes Square, London, S.W.1 (May 30).

PHYSICS GRADUATE with research experience (preferably with a knowledge of electronics) for research in microwave spectroscopy—The Registrar, University College, Southampton (May 31).

SENIOR LECTURERS or LECTURERS IN BOTANY, ZOOLOGY and SOCIAL TRAINING, at the University of Malaya—The Secretary, Inter-University Council for Higher Education in the Colonies, 1 Gordon Square, London, W.C.1 (May 31).

TEACHER OF BACTERIOLOGY AND PHYSIOLOGY—The Principal, College of Technology, Belfast (May 31).

LECTURERS and ASSISTANT LECTURERS IN EXPERIMENTAL AND THEORETICAL PHYSICS—The Secretary, The University, Aberdeen (June 1).

SENIOR RESEARCH OFFICER or RESEARCH OFFICER (Ref. No. 2790) to undertake physiological and biological experiments on marine organisms, chiefly in the aquarium of the laboratory, and a RESEARCH OFFICER (Ref. No. 2791) to take part in the biological programme of fisheries research, at the Marine Biological Laboratory, Cronulla, N.S.W.—The Chief Scientific Liaison Officer, Australian Scientific Research Liaison Office, Africa House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (June 3).

SCIENTIST, Grade II (Ref. TT/214), and a SCIENTIST, Grade III (Ref. TT/125), in the Field Investigation Group of the Scientific Department at London headquarters—The National Coal Board, Establishments Branch (Personnel), Hobart House, Grosvenor Place, London, S.W.1, quoting the appropriate Ref. No. (June 5).

CHAIR OF EDUCATIONAL PSYCHOLOGY—The Registrar, University Office, 46 North Bailey, Durham (June 9).

LECTURER IN SOCIAL ANTHROPOLOGY at Auckland University College, New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (June 17).

ROYAL DUTCH SHELL STUDENTSHIP IN GEOPHYSICS—The Registrar, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7 (June 17).

DIRECTOR OF RESEARCH—The Int. Secretary, Scottish Society for Research in Plant-Breeding, 8 Eglinton Crescent, Edinburgh 12 (June 30).

LECTURER or SENIOR LECTURER IN GEOLOGY at the University of Sydney—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (Sydney, June 30).

ASSISTANT LECTURER IN DAIRYING in the School of Agriculture—The Registrar, The University, Nottingham.

GRADUATE (young) IN CHEMISTRY or BIOCHEMISTRY to assist in, and undertake, research on problems connected with brain metabolism and mental disease—The Director of Research, Runwell Hospital, Wickford, Essex.

GRADUATE as scientific assistant on the wood utilization side of the abstracting and information service, at Princes Risborough—The Director, Commonwealth Forestry Bureau, New Bodleian Building, Oxford.

GRADUATE (preferably with statistics as a special subject) IN THE SOCIAL SURVEY DIVISION of the Central Office of Information—The London Appointments Office, Ministry of Labour and National Service, 1–6 Tavistock Square, London, W.C.1, quoting No. B.J.252.

LECTURER IN THE SCHOOL OF CHEMISTRY—The Registrar, College of Technology and Commerce, The Newarke, Leicester.

LECTURERS (2) IN ELECTRICAL ENGINEERING (one to deal with light current work and the other to deal with power)—The Registrar, Municipal College, Portsmouth.

LECTURER IN PHYSICS in the Department of Pure Science and Metallurgy—The Organiser of Further Education in Rugby, College of Technology and Arts, Rugby.

PHYSICIST or PHYSICAL CHEMIST to undertake research into the physical structure and properties of concrete, especially rheology, at research laboratories of the Cement and Concrete Association, Wexham Springs, Slough—The Secretary, British Cast Concrete Federation, 17 Amherst Road, Ealing, London, W.13.

RESEARCH ASSISTANT to work on problems connected with the breakdown of herbicides in soils—The Professor of Botany, Bedford College, Regent's Park, London, N.W.1.

RESEARCH SCIENTIST (with qualifications in physics and mathematics) as Scientific Officer in the Weaving Department—The Director, Linen Industry Research Association, Research Institute, Lambeg, Lisburn, Northern Ireland.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

National University of Ireland. Calendar for the Year 1948. Pp. x+319+1074. (Dublin: National University of Ireland, 1948.) [311

Bulletin of the British Museum (Natural History). Zoology, Vol. 1, No. 1: On some Species of Lernæa (Crustacea, Copepoda: Parasites of Fresh-water Fish). By J. P. Harding. Pp. 27. (London: British Museum (Natural History), 1950.) 7*s.* 6*d.* [311

Ministry of Labour and National Service: Technical and Scientific Register. Present and Future Supply and Demand for Persons with Professional Qualifications. In Building and Quantity Surveying. Pp. 20. 6*d.* net. In Civil Engineering. Pp. 20. 6*d.* net. In Valuation and Estate Management. Pp. 20. 6*d.* net. (London: H.M. Stationery Office, 1950.) [12

Forty-second Annual Report of the Governing Body of the Imperial College of Science and Technology. Pp. 53. (London: Imperial College of Science and Technology, 1949.) [12

Coal Tar Research Association. Review of Coal Tar Technology, January–June 1949. Pp. 56. (Gomersal, near Leeds: Coal Tar Research Association, 1950.) [12

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 29, 1947. Pp. vi+68. (London: Society of Chemical Industry, 1950.) 21*s.* [132

British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vol. 5, No. 8: Chaetognatha. By S. T. Burfield. Pp. 459–473. (London: British Museum (Natural History), 1950.) 2*s.* 6*d.* [132

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year 1948. Pp. v+58+12 plates. (London: H.M. Stationery Office, 1949.) 2*s.* net. [132

Kind Killing. Compiled by F. Jean Vinter. Pp. 12. (London: Universities Federation for Animal Welfare, 1950.) 3*d.* [132

Directory of Natural History Societies. First Supplement. By H. K. Airy Shaw. (Pamphlet No. 7a.) Pp. 44. (London: Amateur Entomologists' Society, 1949.) 2*s.* [132

Ministry of Fuel and Power. Reports of H.M. Inspectors of Mines for the Year 1948. East Midland Division. Report by W. B. Brown. Pp. 43+3 plates. (London: H.M. Stationery Office, 1950.) 1*s.* net. [142

British Electrical and Allied Industries Research Association. Twenty-ninth Annual Report, October 1st, 1948, to September 30th, 1949. Pp. 188. (Leatherhead: British Electrical and Allied Industries Research Association, 1950.) [142

Bulletin of the British Museum (Natural History). Geology, Vol. 1, No. 3: The Vertebrate Faunas of the Lower Old Red Sandstone of the Welsh Borders—*Pteraspis leathensis* White, a Dittonian Zone-Fossil. By Errol Ivor White. Pp. 49–89+1 plate. (London: British Museum (Natural History), 1950.) 7*s.* 6*d.* [142

British Museum (Natural History). John Murray Expedition, 1933–34. Scientific Reports, Vol. 9, No. 3: Crustacea; Dromiacea. Part 1: Systematic Account of the Dromiacea collected by the *John Murray* Expedition; Part 2: The Morphology of the Spermatheca in certain Dromiacea. By Dr. Isabella Gordon. Pp. 201–253+1 plate. (London: British Museum (Natural History), 1950.) 10*s.* [142

Year Book of the Royal Society of London, 1950. (No. 54.) Pp. 274. (London: Royal Society, 1950.) 7*s.* 6*d.* [142

British Standard 1570: 1949, Flanged Steel Plug Valves for the Petroleum Industry. Pp. 31. (London: British Standards Institution, 1949.) 7*s.* 6*d.* net.

Association of British Chemical Manufacturers. Report on the Chemical Industry, 1949. Pp. 76. (London: Association of British Chemical Manufacturers, 1950.) 5*s.* [152

Ministry of Fuel and Power. Reports of H.M. Inspectors of Mines for the Year 1949. West Midland and Southern Division. Report by H. S. S. Scott. Pp. iv+38. 1*s.* net. South Western Division. Report by T. A. Rogers. Pp. iv+38. 1*s.* net. (London: H.M. Stationery Office, 1949–1950.) [152

Other Countries

Mitteilungen der prähistorischen Kommission der Akademie der Wissenschaften. Band 4, Nr. 6: Die junghallstättische Grabhügel von Krensdorf (Niederdonau), von Josef Tomschik; Die jungshallstättischen Grabhügelfunde von Krensdorf, Marz und Weiden am See (Niederdonau), von Christian Perscheck. Pp. 107–140+9 plates. Band 5, Nr. 4: Spektralanalytische Untersuchungen von Bronzen aus Hallstatt, O.-Ö., ein Beitrag zum Problem der Chronologie des urzeitlichen Kupferbergwesens in Österreich, von Richard Pittioni; Metallographische Untersuchungen an Bronzen aus Hallstatt, O.-Ö., von Friedrich Morton. Pp. 101–127+5 plates. (Wien: R. M. Rohrer, 1943–1949.) [301

Kungl. Svenska Vetenskapsakademiens Handlingar. Fjärde Serien, Band 1, No. 6: Sexual Differences in Size and Structure of the Corpora allata in some Insects. By Nils-Bertil Palm. Pp. 24. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.; London: H. K. Lewis and Co., Ltd., 1949.) 2.75 kr. [311

International Union of Geodesy and Geophysics: Association of Terrestrial Magnetism and Electricity. Bulletin No. 12b: Geomagnetic Indices, K and C, 1948. By H. Herbert Rowe and Evelyn K. Weisman; with 2 Appendices by Julius Bartels. Pp. iv+120. (Washington, D.C.: International Union of Geodesy and Geophysics, 1949.) [311

Bengal Famine (1943) as revealed in a Survey of the Destitutes in Calcutta. By Tarakchandra Das. Pp. vii+154+11 plates. (Calcutta: University of Calcutta, 1949.) 6 rupees. [311

Annals of the New York Academy of Sciences. Vol. 50, Art. 7: Allergy. By Arthur F. Coca, Max Grolnick, Samuel Karelitz, Arthur P. Locke, Miles G. Meyer, Lester Reddin, Jr., Beatrice Carrier Seegal, Marion B. Sulzberger and Matthew Walzer. Pp. 679–814. (New York: New York Academy of Sciences, 1949.) 2.50 dollars. [311

Proceedings of the American Philosophical Society. Vol. 93, No. 6: Natural Selection and Adaptation. Papers read at the Annual General Meeting of the Society, April 21, 1949. Pp. 457–520. 75 cents. Vol. 93, No. 7: The Theory of Relativity in Contemporary Science. Papers read at the Celebration of the Seventieth Birthday of Prof. Albert Einstein in Princeton, March 19, 1949. Pp. 521–548. 50 cents. (Philadelphia: American Philosophical Society, 1949.) [311

Kungl. Skogshögskolans Skrifter. Nr. 1: Skogskulturåtgärdernas ekonomi (Economy of Artificial Regeneration.) Av Thorsten Streyffert. Pp. 54. 2 kr. Nr. 2-3: Tillväxtprognoser vid skogsindelning två problem (Prognosis of Increment for Calculation of Cutting), av Sven Petrini; Simplified Deduction of some Statistical Formulæ, by Sven Petrini. Pp. 12+4. 1 kr. Nr. 4: Om rötskador i granskog och deras betydelse vid framställning av kemisk pappersmassa och silkemassa (Decay Injuries in Spruce Forests and their Importance for the Production of Chemical Paper Pulp and Rayon Pulp.) Av Erik Björkman. Olaf Samuelson, Erik Ringström, Tryggve Bergek och Erick Malm. Pp. 73+2 plates. 3 kr. (Stockholm: Kungl. Skogshögskolan, 1949.) [311

Aggiornamenti di Terapia Oftalmologica. Anno 1, No. 1, Nov.–Dic. 1949. Pp. 23. (Pisa: Aggiornamenti di Terapia Oftalmologica, 1949.) [311

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bd. 147, Nr. 1: The Botanical Expedition to West Greenland, 1946; Introduction with a Short Mention of the Vegetation Areas Examined. By Tyge W. Böcher. Pp. 28. 3 kr. Bd. 149, Nr. 2: Contributions to the Geology of the Area round Jørgen Brønlunds Fjord, Peary Land, North Greenland. By J. C. Troelsen. Pp. 29. 2.50 kr. Bd. 149, Nr. 4: On some Trails from the Triassic Beds of East Greenland. By Eigil Nielsen. Pp. 44. 4.50 kr. Bd. 149, Nr. 5: Observations on the Mesozoic Rocks of. Geographical Society Ø, East Greenland. By Desmond T. Donovan. Pp. 14. 1.50 kr. Bd. 150, Nr. 1: Economic Principles of the Greenland Administration before 1947. By P. P. Sveistrup. Pp. 215. 18.50 kr. Bd. 150, Nr. 3: Über ein Vorkommen von Quartziten der ostern Eleonore Bay Formation an der Nordküste der Wegener Halbinsel in Ostgrönland. Von Heinrich Bütler. Pp. 10. 1 kr. Bd. 150, Nr. 4: Über das Vorkommen von Mitteldevon im südlichen Teil der Giesecke-Berge. Von Heinrich Bütler. Pp. 24+3 plates. 2.50 kr. (København: C. A. Reitzels Forlag, 1949.) [311

Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin. Mathematisch-naturwissenschaftliche Klasse. Jahrgang 1947, Nr. 9: Die Mechanik der Zugförderung. Von Hans Nordmann. Pp. 23. 3.75 D. marks. Jahrgang 1948, Nr. 1: Probleme der durchgehenden Eisenbahnbremsen in entwicklungsgeschichtlicher Darstellung. Von Hans Nordmann. Pp. 20. 2.75 D. marks. (Berlin: Akademie-Verlag, 1949–1950.) [12

Colony of Mauritius. Annual Report of the Royal Alfred Observatory for the Year 1947. Pp. 10. 10 cents. Annual Report of the Royal Alfred Observatory for the Year 1948. Pp. 10. 15 cents. (Port Louis: Government Printer, 1948–1949.) [132

Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin, Mathematisch-naturwissenschaftliche Klasse. Jahrgang 1948, Nr. 3: Die jungalgonkische Regeneration in Raume Amerikas. Von Hans Stille. Pp. 39. (Berlin: Akademie-Verlag, 1949.) 5.25 D. marks. [135

Publications de l'Institut National pour l'Étude agronomique du Congo Belge. Série scientifique, No. 46: An Exploratory Study of Soil Groups in the Belgian Congo. By Charles E. Kellogg and Fidelia D. Davol. Pp. 74+23 plates. (Bruxelles: Institut National pour l'Étude agronomique du Congo Belge, 1949.) 100 francs. [135

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ended June 30th, 1948. (Publication 3954.) Pp. ix+466+100 plates. (Washington, D.C.: Government Printing Office, 1949.) 2.50 dollars. [142

Report of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1949. (Publication 3992.) Pp. ix+149. (Washington, D.C.: Government Printing Office, 1950.) 45 cents. [142

Catalogues

Sunvic Hotwire Vacuum Switches Type P.N. Pp. 4. (London: Sunvic Controls, Ltd., 1950.)

Electric Speedmeters, Indicating and Recording. (Catalogue Sheet 485/5001.) Pp. 4. (London: Everett Edgcumbe and Co., Ltd., 1950.)

Muirhead Technique. Vol. 4, No. 1, January. Pp. 8. (Beckenham: Muirhead and Co., Ltd., 1950.)

Price List of Biological Stains and Reagents. (Price List Y.) Pp. 28. (London: George T. Gurr, 136 New King's Road, S.W.6, 1950.)

Esso Magazine. No. 3, January. Pp. 16. (London: Anglo-American Oil Co., Ltd., 1950.)

TMC Technical Journal. Vol. 1, No. 1, January. Pp. 32. (London: Telephone Manufacturing Co., Ltd., 1950.)

Catalogue of Visual Aids. Pp. 56. (London: W. and J. George and Becker, Ltd., 1950.)

Organic Chemicals for Laboratory Use. Pp. 24. (Freeport, Long Island, N.Y.: Smith-New York Company, Inc., 1950.)

General Literature, Transport, Military and Naval History, Archæology, Anthropology and Folklore, History and Economics. (Catalogue No. 702.) Pp. 86. (London: Francis Edwards, Ltd., 1950.)